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Hollow Ware Made in an Old Shop-I

Molding Methods and Processes Which Have Been in Existence for Years Probably Will Be Retained Even Though Building and Machinery Be Remodeled

BY PAT DWYER

ONE of those irritating people who always is taking the joy out of life by saying clever things before we have an opportunity of doing so, once more has anticipated the sentiment we wish to express by the statement: "We can live without clothes, we can live without books, but civilized man cannot live without cooks." However, we feel that the unknown author might have gone a step further and amplified his statement to the effect that cooks cannot exemplify the rites of their profession without the necessary utensils.

Gradual changes in the methods and appliances used in the preparation of food reflect graphically the advancing standards of civilization. Particularly is this true when considered in connection with the evolution of the iron industry. Contemporary advances were made in many countries but the only point of pertinent interest so far as the present article is concerned is that Abraham Darby, the pioneer user of coal or coke in blast furnaces, in the year 1709 took out a patent on a flask for molding a pot. The methods and appliances employed at the Darby works were guarded jealously for over a hundred years, but despite the surveillance exercised the secrets leaked out.

The first and for that matter many succeeding cooking utensils were cast from direct metal as it came from the blast furnace and it certainly reflects credit on the skill and ingenuity of these early blast furnace men when the crude and primitive methods available at that time are considered.

A study of the early history of this country discloses that in addition to their high hats and their iron wills, the Pilgrim fathers, or at least a few of the number, also brought from England a knowledge of the processes involved in the melting of iron. Thus in 1645, we find that a furnace had been erected

FIG. 1—FIRST CAST IRON POT MADE IN AMERICA

near the site of the present city of Lynn, Mass. and was successfully conducted for many years. In fact, it was not until 1688 when all the available ore in the immediate vicinity and all the wood suitable for making charcoal in the same district had been exhausted, that operations were discontinued.

An operating foundry was built in Taunton, Mass., in 1653 which ran continuously until 1860 when it was merged with other interests. This foundry confined its efforts exclusively to the manufacture of the staple articles found necessary in the early days, including pots, kettles, cauldrons, flat irons, bake pans, fire dogs, andirons, etc. The many foundries built during the closing days of the 18th and the early years of the 19th century, foundries devoted in whole or in part to the manufacture of guns and munitions of war, while interesting in a historical sense have no bearing on the present subject.

The Pilgrims were men of austere and stern demeanor leaning, through choice and necessity, toward the simple life. Food is necessary to sustain life, even of the most simple character and we find that one of the first castings ever made on this side of the Atlantic was a small covered pot or skillet having a capacity of about one quart. This identical pot, shown in the illustration Fig. 1, now forms part of a group in the building occupied by the Lynn Historical Society, Lynn, Mass., illustrating some phases of the development of the iron industry in this country.

The introduction of the cupola as a secondary medium for melting iron marks the beginning of the manufacture of castings on an enlarged scale. The invention by Benjamin Franklin of the heating stove which bears his name and the first cook stoves, as we know them

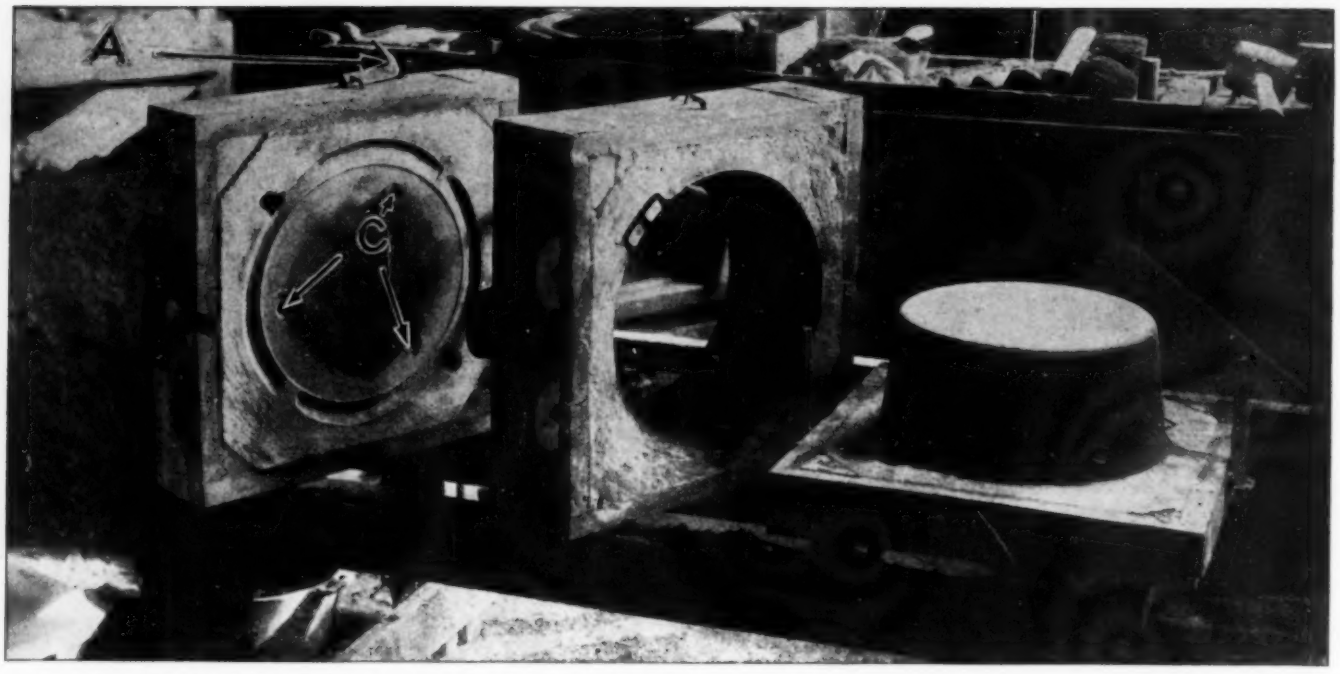


FIG. 2—THE POTS ARE MOLDED BOTTOM UP IN ACCURATELY FITTING, 3-PART LIGHT WOODEN FLASKS

today, which appeared about 1840, were made possible by the ever increasing extent to which this method of melting iron was adapted.

With the constant increase in the population, the needs of the people multiplied and the foundries were called upon to handle a continually increasing volume and a greater and more widely diversfied range of castings. Gradually many manufacturers found it more profitable either to limit the number of lines they handled or to specialize in one particular branch of the industry.

Named After Indian Chief

Among the earliest founders to adopt this policy were those engaged in the manufacture of stoves and hollow ware. Many features shared in common by both these classes of castings, both in the foundry and at their ultimate destination, made it common practice to produce them in the same shop. Even to the present day many shops handle both stoves and hollow ware, but as a general rule the two branches have been divorced and the majority of shops specialize in one or the other of the two branches.

One of the earliest companies in the country to specialize in this class of work was the Wapak Hollow Ware Co., Wapakoneta, O. Not that it has any bearing on the subject, but as a possible point of interest it might be mentioned that the town is named after a famous Shawnee Indian chief and is built on the site formerly occupied by an Indian encampment alongside the great northern trail which led from the crossing on the Detroit river southward until it struck the Ohio approximately at the point now occupied by the city of Cincinnati.

The foundry property recently has been acquired by a new company which while retaining the original name, intends to modernize the plant. The molding and melting practice will remain substantially the same, the contemplated changes involving principally the power factor, the adaptation of molding machines to the peculiar problems involved in this class of work; the flooring and the method of handling the material constituting the cupola charges.

Taking them in the order indicated, it is proposed by installing suitable electric motors to rearrange the groups of shafting and pulleys employed for driving the cupola blower, the tumbling barrels, and the grinding, polishing and buffing wheels. The source of available electric energy in the vicinity is in a rather unsettled condition at the present time, but as soon as suitable arrangements can be made the buildings will be equipped to take advantage of it. In

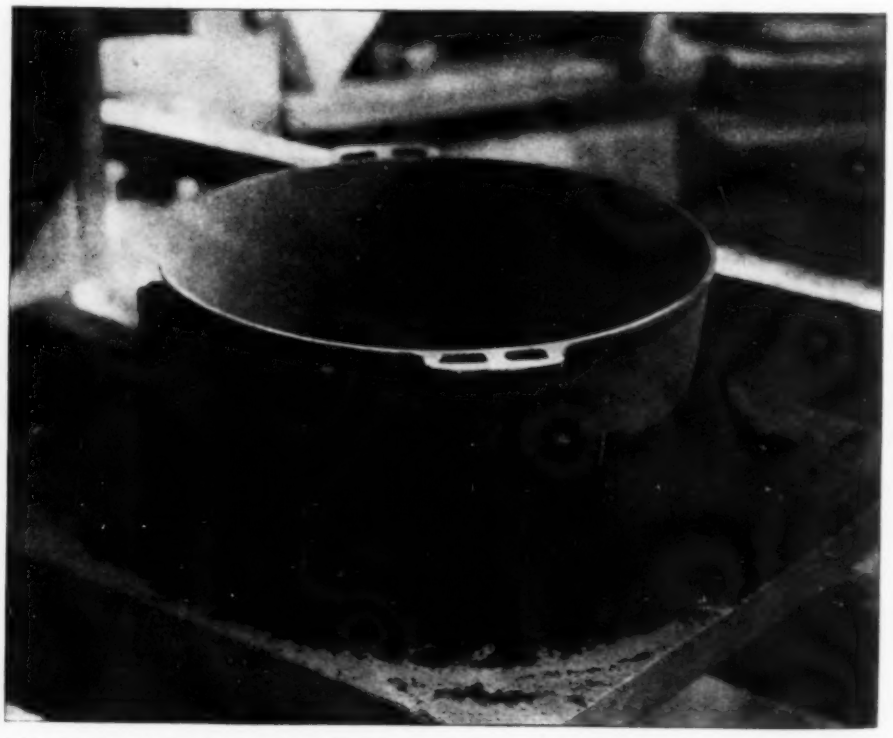


FIG. 3—RIDDLED SAND IS BANKED AROUND THE PATTERN IN THE MANNER INDICATED BEFORE THE CHEEK IS SET ON

addition to proving more economical, from an operating stand point it is claimed that the electrical installation will be more flexible and lend itself more readily to unit control.

For years, the power for driving the various appliances has been supplied by a 15 x 24, 75-horsepower steam engine made by the Brownell Co., Dayton, O. It is housed in a building adjoining the grinding room. The shafting for all the machinery, including the cupola blower, is driven from one main line shaft and consequently when a belt breaks at any point it is necessary to shut down the engine until repairs have been effected.

The many peculiar and delicate problems encountered in the manufacture of hollow ware do not lend themselves readily to ordinary molding machine methods, but Fred Burgoyne, foundry superintendent, has practically completed arrangements to adapt machines to the need. Since the inception of the business, the various castings have been made with no other aid in the mechanical line than the usual follow board. The only exception to this rule is in the case of the sad irons. The patterns for these castings are mounted on stripping plate machines and will be described later in more detail.

A level cement floor has been substituted for the comparatively uneven sand floor which has done duty for so many years. This innovation is in line with modern foundry practice especially in shops devoted to the manufacture of stove plate and light castings generally. It is particularly necessary in the manufacture of hollow ware. A slight deviation from the horizontal in the position of a mold readily may prove a factor in producing a defective casting, owing to the extremely thin metal section and the comparative ease with which the molten metal can force the delicate green sand core over against one side of the mold.

FIG. 5—IN ADDITION TO THE HOOKS AND EYES IN THE SIDES OF THE FLASKS A CLAMP IS PLACED AT EACH CORNER BEHIND THE RUNNER

The method of transporting iron and coke from the yard to the charging platform is shown in Fig. 7 and will be taken up more in detail in the proper place. For the present, it is sufficient to say that it has proved quite satisfactory in the past when a comparatively light tonnage was melted. The output recently has been practically doubled and a modern elevator is being installed to handle the cupola charges.

Two typical castings have been selected for illustrating the methods employed in this foundry. One is the pot shown in Figs. 2, 3 and 4 and the other is the gate of sad irons shown in Fig. 6 Pots are made in a great variety of sizes, ranging from little ladles having a capacity of half a pint for melting sealing wax to large so called sugar kettles capable of holding 50 or 60 gallons. These sugar kettles were used extensively in the maple sugar industry. At the present time, while a few still are used for that purpose, the great bulk of the castings have been diverted to other channels; the two principal customers being farmers and butchers.

A fine grade of Zanesville, O., sand is employed for making all the castings produced in this foundry. The size of the various castings has no particular bearing on the choice of molding sand since the metal thickness varies but slightly between the largest and the smallest. The sand is fine-grained and produces a smooth skin on the castings. It has a good bond, a feature which facilitates the molding operations and insures a sharp, clean parting. However, it must be rammed carefully and vented with a wire quite freely. This latter precaution applies particularly to the part of the mold forming the interior of pots, kettles, skillets, etc.

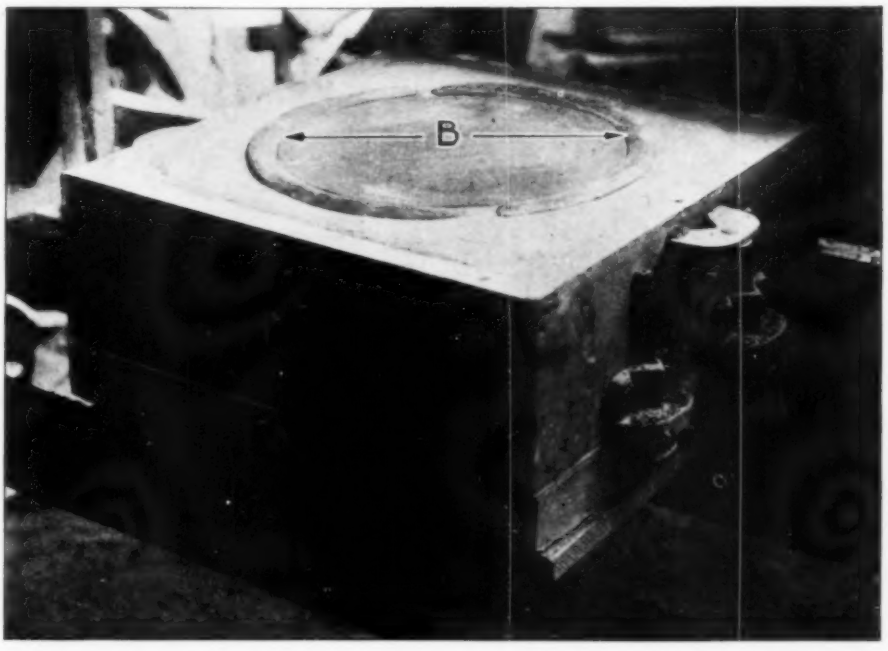


FIG. 4—THE SET GATE SURROUNDING THE PATTERN IS FLAT ON THE UNDER SIDE AS IS INDICATED

Molding a Pot

The illustrations Figs. 2, 3 and 4 show the successive steps and also the style of flask, pattern and other equipment employed in molding a pot. When the molding machines have been installed, iron flasks will be furnished to make these molds, but until the present time wooden flasks have been found quite satisfactory. It will be noted that the sides of the flask are made of comparatively light lumber, only 1¾ inches, but to counteract the tendency of such

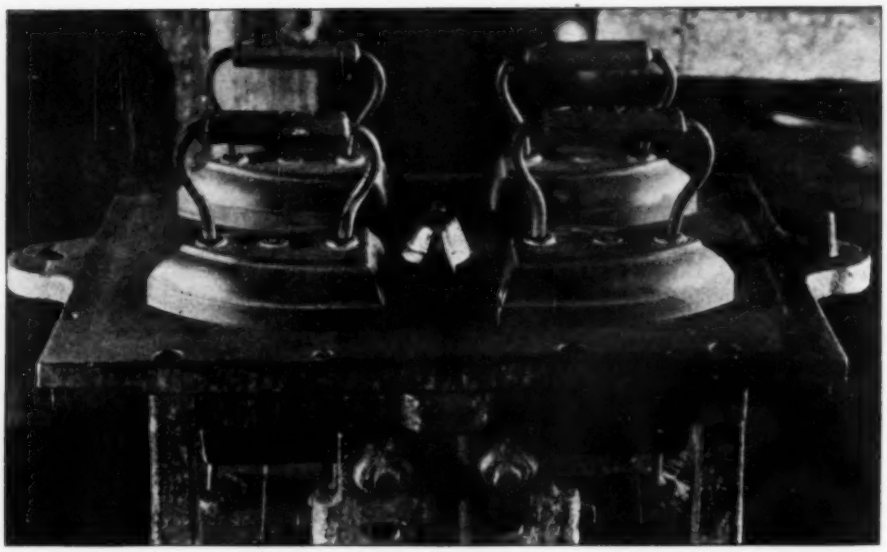


FIG. 6—AFTER THE PATTERNS ARE STRIPPED THROUGH THE PLATE THE HANDLES REMAIN IN THE SAND OF THE COPE

a flask to warp out of shape, corner blocks are nailed firmly in each corner on the inside and the exterior of the corners are reinforced with strips of zinc.

Accurately fitted guides and guide pins are attached to each flask at the parting lines. Those on the drag are made extra long to assist the molder in removing the cheek from the pattern. Hooks and staples, one of which is shown quite clearly at *A* Fig. 2, are attached permanently to the sides of the flask and serve to hold the different parts together while the molder is ramming the sand. Since the metal thickness in these castings does not exceed an average of ⅛ inch it follows that the most extreme care and accuracy are necessary in assembling the parts of the flask that go to make up a complete mold.

Made on a Bench

In molding the pot shown in Figs. 2, 3 and 4, the molder places the follow board on his bench, adjusts the pattern and banks a quantity of riddled sand around the outside as shown in Fig. 3. The bench is a simple, open, wooden frame provided with an elevated shelf at the back to hold the molder's tools, etc. It is light and portable and is easily moved by gradual stages from the front to the back of the floor as the day's work progresses.

The cheek or middle section of a 3-part flask is placed around the pattern, after which sand is shoveled into the flask and rammed as high as the upper edge of the flask which also corresponds with the upper edge of the pattern. A round wooden cover designed to fit closely inside the pattern and supported on suitable ribs which bring it flush with the top edge of the pattern, is provided to prevent any sand from falling into the pattern while the molder is engaged in ramming the cheek. A number of the workmen favor this method while others prefer to fill the inside of the pattern with sand before ramming the outside.

A sufficient quantity of sand is placed in the cheek so that only one ramming is necessary. The molder goes around the pattern once with the peen of the rammer and once with the butt. The excess sand then is scraped off and parting compound sprinkled on the joint. In case the cover referred to in the preceding paragraph has been used it is now taken out, after which the drag part of the flask is set on the cheek. The hooks on the side of the cheek flask are inserted in corresponding staples in the drag. Having assured himself that the parts of the flask are properly arranged, and this is more a matter of instinct and intuition than actual examination, the molder fills the drag with sand. The peen rammer is not employed on the drag. The sand forming the inside of the mold is pressed down with the hands after which the entire upper surface is gone over with the butt rammer. It then is scraped off and vented with a wire and after several narrow channels have been scraped with the fingers to permit the gas to escape freely, the bottom board is set on and the mold rolled over.

Circular Set-gate

After the follow board has been removed the semicircular *set-gates* shown at *B* Fig. 4 are placed as indicated. These gates are flat on the joint side and convex on the upper or cope side. They are generous in proportion, but the edge which comes into contact with the rounded bottom of the pattern is extremely thin and consequently breaks off quite readily after the casting has been poured. The three loose pieces of pattern to form the legs with which many of these pots are provided also are set on at this time. Parting compound is sprinkled over the joint after which the cope is set on and hooked to the drag. Two gate pins are set diametrically opposite each other, each one touching the semicircular flat *set-gate*. Then the cope is filled with sand and rammed.

The hooks on the sides of the flask first are disengaged and then the cope is lifted off and set down on the bench as shown in Fig. 2, where the loose leg patterns are withdrawn. The cheek is lifted off next and set down beside the cope. The pattern is rapped lightly with a wooden mallet and lifted off

FIG. 7—A JIB CRANE IS EMPLOYED TO LIFT THE MATERIAL TO THE CHARGING PLATFORM OUTSIDE THE BUILDING

the drag. Instead of inserting a screw in a threaded hole in the center of the pattern bottom, or of sticking a couple of spikes in holes provided for that purpose on the sides, the pattern is withdrawn by the simple expedient of grasping the sides firmly between the palms of the two hands. The entire mold disassembled is shown in Fig. 2.

A light coating of plumbago is brushed on the cope immediately in front of the gate and also over the entire top face of the body of sand standing up in the drag. The mold then is re-assembled and placed on the floor where it forms one of a group similar to that shown in Fig. 5. The work is all made on a piece-work basis and the number of pots or other utensils made in a day varies according to the size. The man making the pot shown in Fig. 2 puts up 40 for a day's work. He also pours his own work, shakes it out and cuts his sand. While the men work singly they *double up* when pouring the iron, that is two men pour each floor. In many instances, as in the pot shown in Fig. 5, the molds are poured *two up*, but even in cases where only one runner is provided the men are accustomed to pair off when pouring their work. A certain amount of knack or skill is required in pouring castings of this character, hence when two men become accustomed to pouring together they remain in partnership in this respect even though in the course of time their respective floors become widely separated.

Cast Iron Ladles Used

The ladle and shank shown in Fig. 9 is typical of all those employed. The bowl has been cast, using one of the pot patterns for a pattern. It will be noted that the shank at one end is provided with a swivel. This is to prevent any misunderstanding between the two men engaged in handling the ladle. The man at the fixed end controls all movements absolutely. The bowls for the hand ladles also are made of cast iron, a smaller pot pattern being used for that purpose. A small brick oven located near the cupola room and heated by a number of steam coils laid in the form of shelves is employed for drying the ladles. The steam is supplied by the same boiler which furnishes steam for the engine and also for the long overhead coils by which the shop is heated in the winter time.

One of the stripping plate machines provided for making the sad irons is shown in Fig. 6. The molds are rammed by hand, the only function of the machine being to provide a perfectly plane joint surface and to strip the patterns. The handles for the sad irons are made on one of the benches, a metal match plate being employed for

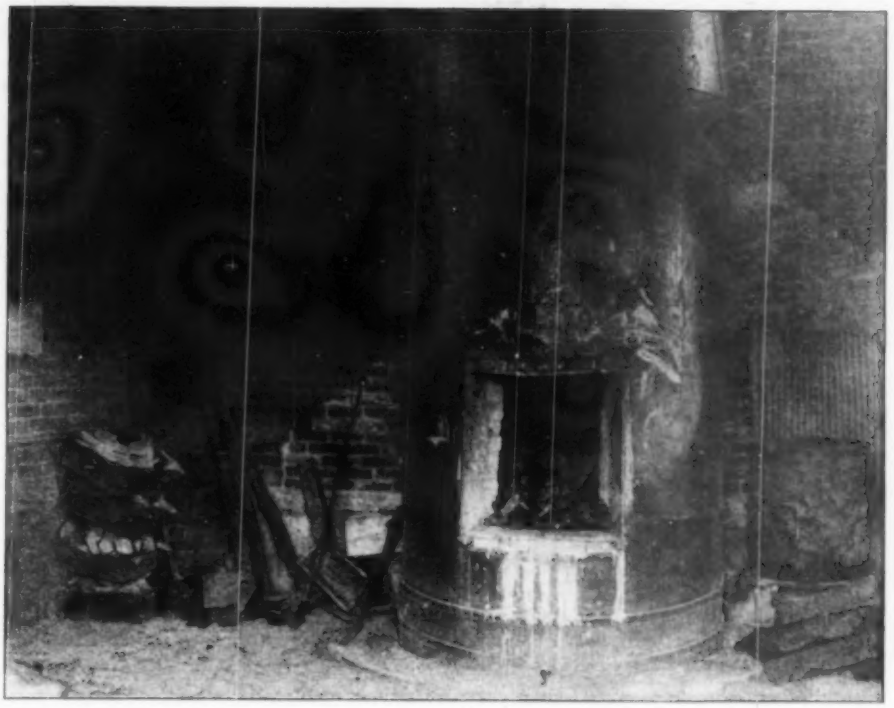


FIG. 8—THE SPRUE AND GATES ARE GATHERED INTO SMALL WOODEN BOXES FOR CONVENIENCE IN CHARGING

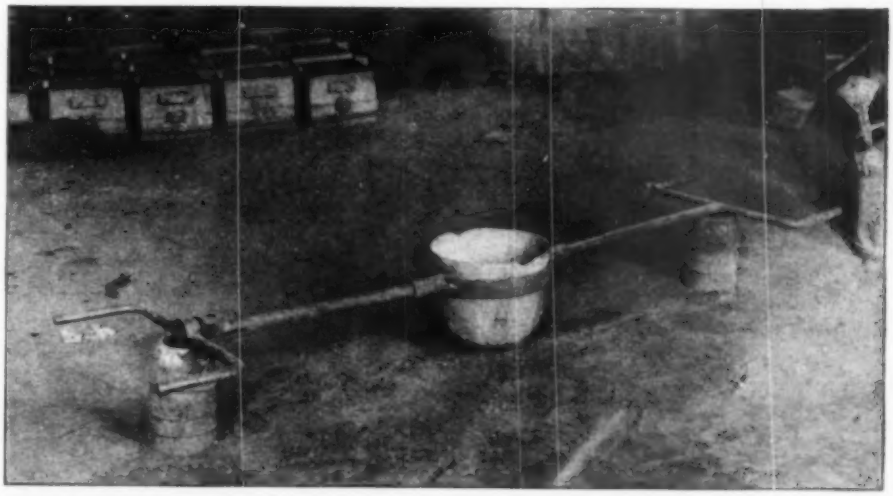


FIG. 9—CAST IRON LADLES ARE USED EXCLUSIVELY

FIG. 10—CEMENT POOL FROM WHICH THE MOLDERS GET THEIR WATER

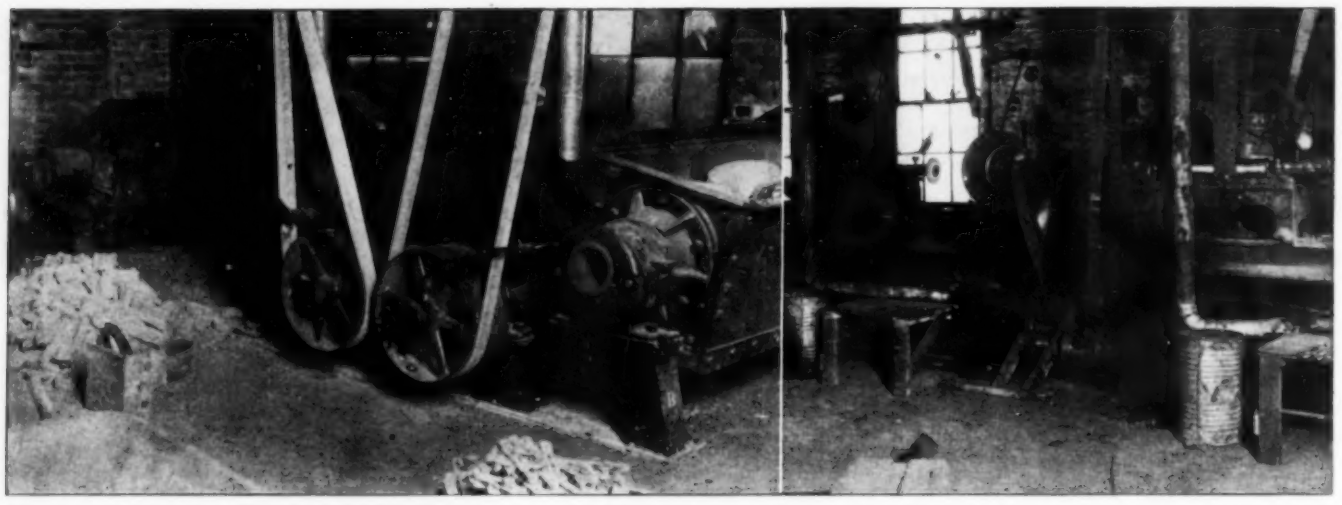


FIG. 11—IT IS CLAIMED THAT CASTINGS CAN BE CLEANED QUICKER AND WITH LESS BREAKAGE IN SQUARE TUMBLING BARRELS THAN IN THOSE OF CYLINDRICAL CROSS SECTION FIG. 12—PART OF ONE BATTERY OF GRINDING WHEELS PROVIDED WITH SPECIAL ATTACHMENTS FOR GRINDING SKILLETS

the purpose. The short steel rods, perfectly straight and cut to length are laid in the molds and the iron poured around them. After they have been cleaned on the following day they are taken to one of the departments on the second floor of an adjoining building and placed in a press where the steel rods are bent to the require shape.

The extremities of the handles fit loosely in suitable holes provided in the patterns and consequently when the mold has been rammed and the patterns stripped down through the plate, the handles remain in the sand forming the mold. In accordance with accepted foundry practice, the finished face of the irons is cast down, in other words all of the mold is in the cope. The drag simply presents a plain, flat surface on which to rest the cope.

Melting the Iron

During a long and active career, the cupola has been changed, repaired and adapted so many times that its original identity has been lost. The present management has modernized it and brought it up to date by adding a second branch to the main wind pipe so that the blast enters both sides of the wind box, and also by substituting a continuous tuyere for the six small tuyeres which formerly served to deliver the air. The tuyeres are comparatively low as is customary in shops where the greater part of the iron is caught in hand ladles and where the stream rarely is stopped until the furnace is empty.

The cupola is lined to 42 inches and the iron and coke charges are made up of 1000 pounds and 200 pounds respectively. Several brands of pig iron are used, the supply depending to a considerable extent on market conditions, but it is intended to have on hand material for a mixture having the following analysis: silicon 2.75 per cent; sulphur, 0.05 per cent; phosphorous, 0.75 per cent and manganese, 0.60 per cent.

The blast is furnished by a No. 5 positive pressure blower made by the Piqua Blower Co., Piqua, O. At present, as intimated elsewhere, it is belt driven from the main line shaft, but eventually it will be driven by an individual motor.

A spur track connecting with the Baltimore & Ohio railroad extends back of the cupola room. The pig iron, coke and scrap are unloaded on both sides of the track and a hand truck is employed to convey the different materials to a point in front of the charging floor where they are picked up by a light jib crane and landed on the charging platform. It will be noted that two extensions to the charging floor are provided, one designed to hold the coke and the other the iron. The hoisting rope on the crane is led over a number of sheave wheels into the main building where the end is attached to a drum on the main shaft controlled by a friction clutch or band. The controlling lever for the device is located outside the cupola room, under the platform so that the operator can watch the load.

Dropping the Bottom

An open frame to act as a drag is placed on the floor under the cupola bottom before the doors are put up. A length of wire cable is attached by one end to the frame, the other end

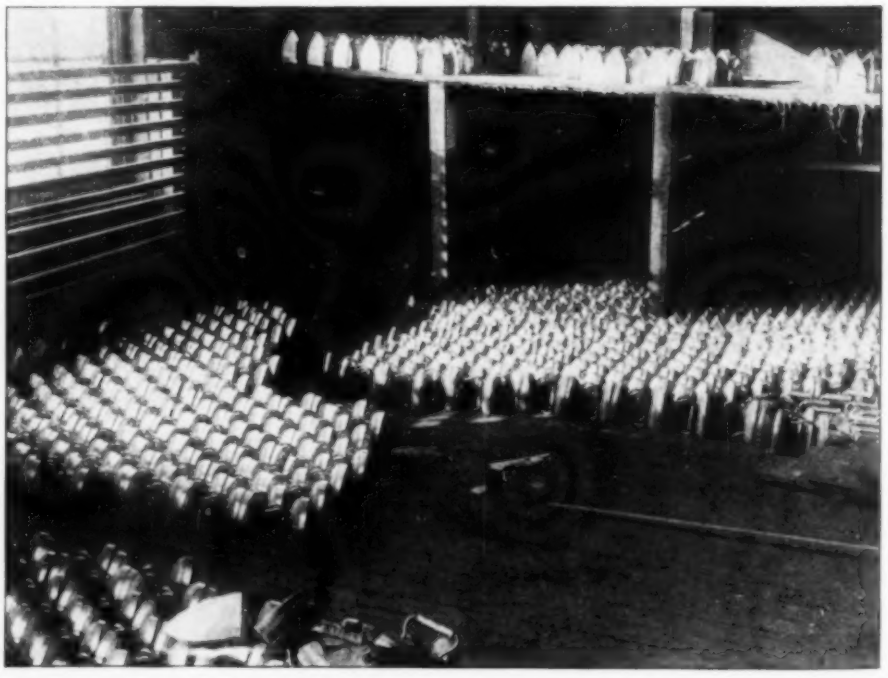


FIG. 13—SAD IRONS IN ONE CORNER OF THE STOCK ROOM ON THE SECOND FLOOR SHOW THE LARGE STOCK CARRIED

terminates in a loop which is slipped over the hook on the charging floor hoist when the time comes to drop the bottom. All the cupola tender has to do when the heat is over is to pull the lever which tightens the friction band on the hoisting drum. The frame not only pulls the prop from under the cupola doors, but it also pulls the greater part of the *drop* to a point where it cools off to better advantage than if it remained where it fell.

The old cleaning room with its battery of cylindrical tumbling barrels has been dismantled and the floor space utilized for molding purposes. Another part of the building has been equipped with a battery of square tumbling barrels made by the Whiting Corp., Harvey, Ill. Part of the installation is shown in Fig. 11. It is claimed by the management that their product can be packed to better advantage in a mill of rectangular cross section. The dust arrester erected in connection with the tumbling barrels and which also serves the wheels in the grinding department was made by Knickerbocker Co., Jackson, Mich.

The castings are ground, polished, some of them nickel plated, painted, packed and shipped in the various rooms in a large 3-story building adjoining the foundry. The same building also houses the pattern shop and pattern storage and the general office of the company. The methods of grinding and finishing will be described in a second article which will appear later.

Accuracy Insured on Wooden Matchplate

BY A. LANDERER

ADJUSTING the two halves of a split pattern on a wooden match plate or mold board requires patience and the most extreme care. The sections must register exactly opposite each other, otherwise the castings produced from them will be defective on account of an uneven joint along the parting line. Some patterns are more difficult to mount than others; but the plan adopted for mounting the valve seat patterns shown in the accompanying illustration was much simpler than the one usually employed and with variations may be adapted to any pattern symmetrical in cross section.

Before starting to make the plate, enough stock to make the eight patterns was glued and set away to dry. The plate was made of cherry ⅞-inch thick, jointed and glued strongly and accurately and having a strip dove-tailed all the way across each end to prevent it from warping. The outside dimensions of the plate corresponded to the size of the flask in which the valve seats were to be made, in this case 14 x 20 inches. A full size drawing of the body block of the pattern was inscribed on a small layout board and with that as a guide, two templets were made, one for the top and one for the bottom.

Referring to the illustration, Fig. 2, it will be noted that the pattern blocks are larger where they are incorporated with the plate than elsewhere. The shoulder or check thus provided at top and bottom serve to locate each pattern in its proper relative position up and down in the plate. In other words the check line top and bottom on the patterns corresponds to the top and bottom surface of the plate.

The eight patterns were turned out of end wood, that is the grain of the wood ran in the direction indicated in Fig. 2. The principal reason of course for using end wood was to prevent distortion of the patterns while in use. The patterns were turned first, using the templets to secure the proper contour top and bottom. The distance between the shoulders was made to conform accurately to the thickness of the plate. The patterns then were set to one side until the holes were prepared in the plate to receive them.

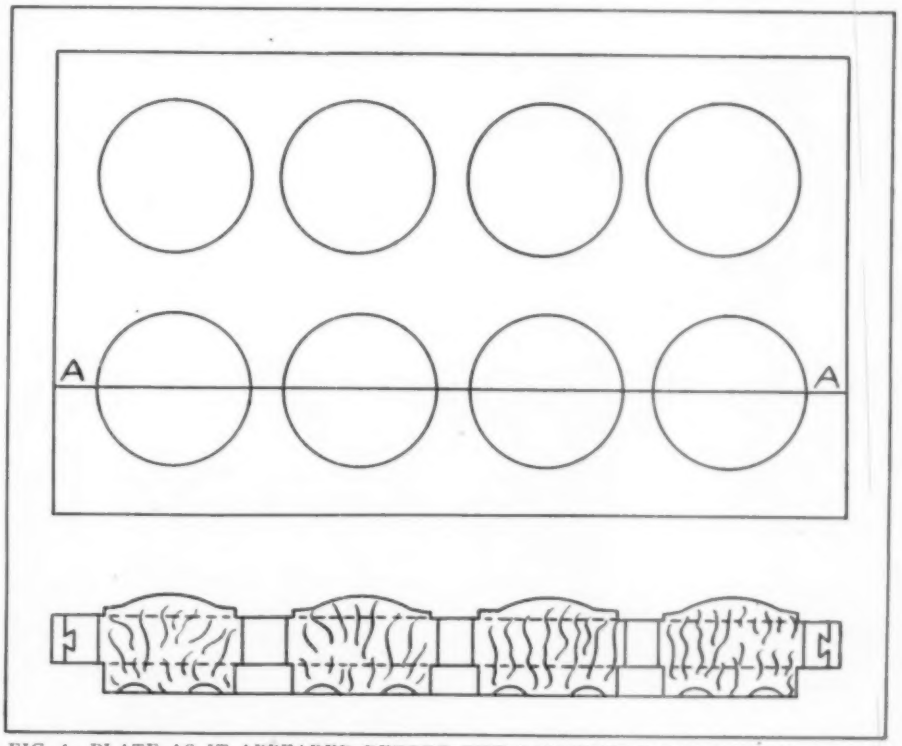


FIG. 1—PLATE AS IT APPEARED BEFORE THE PATTERNS WERE INSERTED FIG. 2—SECTION OF PATTERN PLATE AT *AA* WITH PATTERN BLOCKS IN PLACE

Any one of several methods might have been adopted for cutting the holes through the plate; but prevailing conditions and the lack of certain equipment led to the decision to turn the holes on the lathe. A 36-inch face plate was selected for the purpose. After laying out the eight holes on the pattern plate a small hole was drilled through the center of each one. Taking each hole in turn it was centered on the face plate of the lathe. A 3-inch nail was employed to feel for the center of the plate and when located No. 12 screws were inserted in the remaining holes and driven into the face plate of the lathe. Blocks screwed on the outside of the pattern plate served to hold it in place while turning the last two holes. Pieces of scrap lumber attached to the face plate of the lathe and shifted each time a new hole was centered served to keep the face plate balanced and running true.

To provide for any small variation in the diameter of the holes a different pattern was tried in each one and fitted. Corresponding marks were placed on each pattern and hole and after they were all fitted they were glued and bradded in place.

Protects Thermocouple With Wash

Graphite and Clay Washes Applied to Pencil Type Thermocouples Used in Molten Aluminum Greatly Increase the Life of the Couple—Simple Method of Applying the Washes is Detailed

BY KIRKLAND MARSH

TEMPERATURE control in aluminum remelting practice has not been extensively adopted because of the difficulty of maintaining thermocouples in molten aluminum. Nearly all common metals are readily soluble in molten aluminum and those used in the construction of thermocouples are no exception.

A thermocouple used in molten aluminum, without a sheath or other means of protection, is rapidly attacked and quickly rendered unfit for use. Even the

FIG. 2—SECTIONS OF USED THERMOCOUPLE BELOW SHEATH ON THE LEFT AND ABOVE SHEATH ON THE RIGHT

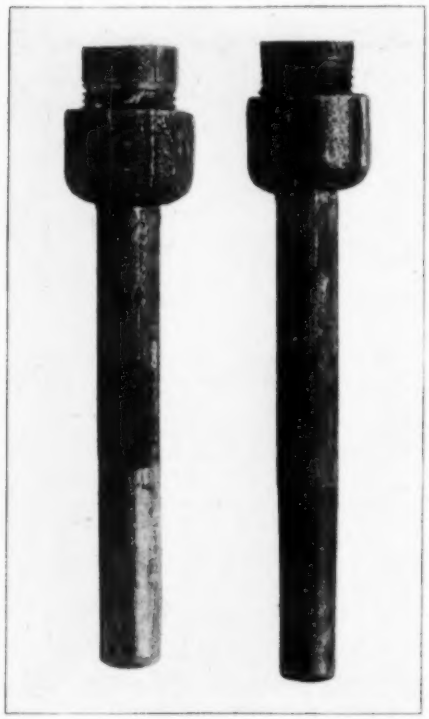


FIG. 1—THERMOCOUPLES BEFORE USE —NO. 72-24, LEFT AND NO. T-72-1, RIGHT

pencil type of thermocouples, consisting of an insulated wire of one material enclosed in a tube of the other material and welded together at the hot junction, will not withstand the action of the molten aluminum for long.

If a protection sheath is used on the thermocouple, so much lag is introduced that the length of time required to attain temperature equilibrium is often prohibitive, particularly in the case of a portable pyrometer used for intermittent readings of the temperature of metal in ladles, just previous to pouring.

Precedent Pointed Way

In endeavoring to determine some means of protecting thermocouples from molten aluminum, the technical direction bureau, the Aluminum Co. of America, tried out a method of protection which has been used to a greater or less extent for the prevention of similar action in cast-iron aluminum remelting pots.

According to this method the thermocouples are given a protective coating of a thin layer of plumbago, which is in turn coated with a thin layer of lime. Up to the present time this process has been used only in conjunction with iron-constantan thermocouples of the pencil type, the outside diameter of which is about 9/16 inch. Whether this method of protection is applicable to thermocouples consisting of two wires welded together has not been determined.

The following directions for preparing and applying the coatings of lime and plumbago to the thermocouple were drawn up from the results of trial and experiment. Further experience may bring improvements in the method but the results already obtained seem to warrant the publication of the facts for the benefit of the foundryman handling aluminum.

The coatings of plumbago and lime are applied to the thermocouple in the form of a wash and should extend well above that part of the thermocouple immersed in the metal. The plumbago wash consists of one part, by volume, of plumbago and two parts water. The lime wash consists of one part, by volume, of slaked lime, calcium hydroxide, and one part water. Since both the lime and plumbago will settle out it is necessary to stir the mixtures thoroughly before using them. In applying the washes the thermocouple should first be cleansed of any loose scale and then heated in air to 900 or 1000 degrees Fahr. At this temperature it is dipped in the plumbago wash, quickly withdrawn and allowed to dry, and then dipped in the lime wash and quickly withdrawn. The heat in the thermocouple will generally be sufficient to dry both coatings but, if not, they should be thoroughly dried by heating. The thermocouples can then be immersed in the molten metal and the temperature observation made in the usual manner. Inasmuch as the coatings are nonresistant to abrasion, care should be taken to see that the thermocouple does not come in contact with any solid sub-

FIG. 3—THERMOCOUPLES AFTER USE —NO. 72-24, LEFT AND NO. T-72-1, RIGHT

The author, Kirkland Marsh, is pyrometric engineer, the Aluminum Co. of America, Pittsburgh.

stance which would rub off the coating.

One application of the washes is good for a number of readings; in fact, the thermocouple can be used without dipping as long as the coatings are still intact. However, the effectiveness of the coatings is greatly reduced when the molten aluminum has once penetrated them and attacked the metal of the thermocouple, because it is difficult to completely remove the aluminum from the thermocouple and the dissolving or alloying action will continue under any subsequent coating. Therefore, it is better to recoat the thermocouple more frequently rather than to wait until the former coating has proved defective, especially since it is difficult to determine the condition of the coating if a little aluminum clings to the surface when the thermocouple is removed from the metal. One application of the washes should be good for from 10 to 25, or even more, readings, depending on the conditions of service.

Cleaning The Rod

When the thermocouple is to be recoated it should be freed of all clinging metal by pushing it through a pile of furnace skimmings, or sand, as soon as it is removed from the metal. If the thermocouple is still hot enough—900 to 1000 degrees Fahr., it may be dipped immediately into the washes in the same manner as before, but if too hot, it should first be allowed to cool to the proper temperature. In cleaning the thermocouple it is necessary to remove only the clinging metal and any loose scale, for any firmly adhering oxide scale will increase the protection and therefore should not be removed.

Suitable containers for the washes can be made of a 4-inch pipe capped on one end and long enough to give the required depth of immersion plus about 8 inches. The extra length of tube will retain any of the wash which is spattered about when the hot thermocouple is dipped.

By having a set of containers at each end of a row of furnaces and reversing the order of readings each time, the operator may clean and dry the thermocouple after the last reading without returning to the first furnace.

The corrosion of the thermocouple, principally by oxidation, will continue even under the protective coating, so the thermocouple will not last indefinitely, but if the coating is maintained intact the thermocouple will be unaffected by the molten metal.

In order to protect that part of the thermocouple which is not in the molten metal but is in the combustion chamber, or otherwise subjected to red heat, it is well to enclose it in a sheath. Such a sheath is shown in Fig. 4. It is made of pipe and pipe fittings and can be calorized or not as conditions warrant. In addition to protecting the thermocouple from oxidation it also adds strength, which is a distinct advantage in case any considerable length of the thermocouple is heated to a red heat, inasmuch as it keeps the thermocouple from being bent. If four or five inches of the thermocouple are allowed to project beyond the end of the sheath no appreciable temperature lag will be introduced.

Conserving The Thermocouple

When that part of the thermocouple which has been constantly immersed in the molten metal becomes so badly corroded as to be unfit for further use it can be sawed off and the remaining part rewelded. If a sheath such as is mentioned above is used, only that part of the thermocouple which projects beyond the sheath will have to be cut off.

The following data from one test will soon give some idea of the effectiveness of the protective coating. In this case a thermocouple of the pencil type, connected to a portable indicator, was used every half hour to measure the temperature of the molten aluminum in

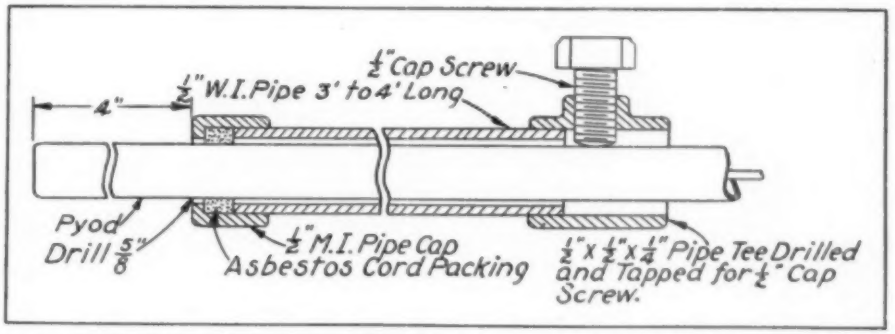

½" Cap Screw
½" W.I. Pipe 3' to 4' Long
4"
Pyod
Drill 5/8"
½" M.I. Pipe Cap
Asbestos Cord Packing
½" x ½" x ¼" Pipe Tee Drilled and Tapped for ½" Cap Screw.

FIG. 4—DIAGRAM SHOWING THE METHOD OF ATTACHING THE SHEATH

from 4 to 7 furnaces, depending upon the operating conditions. Two thermocouples were taken at random and equipped with the type of sheath already mentioned and calibrated with the instrument with which they were to be used. The first thermocouple, T-72-1, was coated after each set of readings with the plumbago and lime wash, as described. Accurate data were kept of the number of hours of actual service, number of sets of readings and the number of readings for which the pyod was used. This pyod which was used only during the day, when it could be closely observed, was kept in service until it was broken while being straightened, after having been accidently bent. This occurred after it had been in use for several weeks, during which time it was recalibrated at least once a week. No change in calibration was noted over the entire period. The second thermocouple, 72-24, was then put in service under the same conditions except that it was not protected by the plumbago and lime coatings, and was used until the molten aluminum had penetrated the iron tubular elements and thereby rendered it unfit for use.

The following table shows the results of this test:

Thermocouple	Hours of Service	Sets of Read'gs	No. of Read'gs
T-72-1 (Coated)...	306½	553	2416
74-24 (Not coated).	71½	132	514

When thermocouple T-72-1 was removed from service, because of breakage while being straightened, it was, aside from the fracture, still in good condition and would probably have been good for 400 or 500 more readings.

As is shown by Fig. 3, the molten aluminum does not attack the thermocouple evenly over the entire exposed surface but in spots. While some parts of the surface show little or no effect, other parts are badly attacked. At the point indicated by the arrow, the iron was completely dissolved, leaving the inner constantan element exposed. After the molten aluminum has completely dissolved the iron sheath element of a thermocouple, at any spot, and thereby exposed the constantan element, the thermocouple becomes unreliable and should be withdrawn from service.

The use of plumbago and lime protective coatings on thermocouples of the pencil type has proved satisfactory in several plants where it has been tried out. As the data from one specific test show, the life of one of these thermocouples is materially increased. The cost of using this method of thermocouple protection is small, therefore, the expense of maintaining pyrometers for measuring the temperatures of molten aluminum can be greatly reduced.

It is possible that the method described for protecting thermocouples for use in molten aluminum can also be applied satisfactorily to brass melting, but as this possibility has not been investigated no recommendations can be made.

Scrap Should Prove Object Lesson

By an Intelligent Examination of the Castings Classed as Scrap the Foundryman in Many Cases Can Adopt Means to Prevent a Recurrence of the Same or Similar Trouble

BY F. H. HURREN

AT a recent annual meeting, F. H. Hurren, president of the Coventry branch, the youngest and largest branch of the Institution of British Foundrymen, devoted his presidential address to the subject of "Wasters". He affirmed that the question of scrap castings was vital in every foundry, although all foundries underestimate the percentage of scrap made. In most shops there is a desire to hide a waster as soon as discovered. This practice does not tend to the reduction or elimination of scrap, and no waster should be broken up until an inquest has been held on it by all the men concerned in its production. More knowledge may be gained from the examination of one failure than from a hundred successes. While wasters are produced for which no reason is apparent, there must, of course, be a reason.

Causes and Remedies

The president described a few examples of scrap castings observed by him during the last few years with a view to explaining the causes and remedies. The most common causes of scrap castings are:—short pours, run-outs, mis-runs, cold shuts, cold shots, crushes, scabs, blows, cross-joints, cross lifting, contraction cracks, cores broken, strain or swell, presence of dirt or slag, sponginess, porosity, and hard spots. In addition, there were many other causes less common, such as segregation of alloy, and oxidized metal. The list, although formidable, only touched the fringe of the subject. Short-pours and run-outs are in most instances due to carelessness, and the remedy lays in the hands of the molder. When a mold bursts at the joint, the usual practice is for everyone to get excited and throw sand at the stream of metal, causing it to splash and to burn the clothes of the unfortunates in the immedaite neighborhood. A piece of clay on a bod stick of the kind used for the cupola quietly applied at the joint in the molding box, usually would effect a stoppage. If the run-out is too big for this, it is better to leave it alone and not waste any more metal.

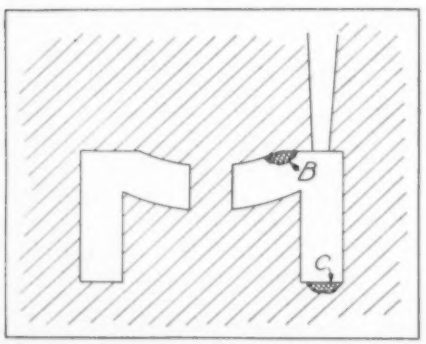


FIG. 1—SAND BROKEN AWAY AT *C* FLOATS UP AND LANDS AT *B*

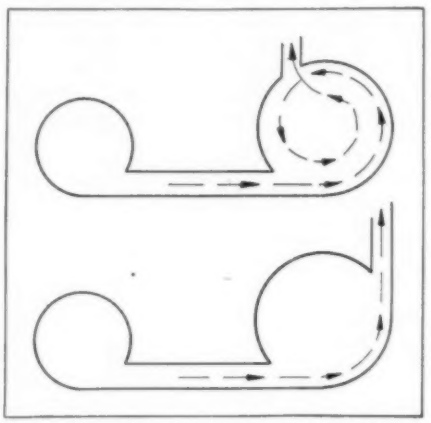


FIG. 2—SHOWING TWO METHODS OF CUTTING A SKIMMER GATE

In connection with run-outs, the question of weighing molds ought to be considered. Molten metal has a lifting effect and unless this is counteracted, the top part of the box is liable to float, causing a run-out. The lifting pressure depends on the area of the surface of molten metal in contact with the top box and also the relative height of the pouring head. A fundamental fact to be remembered, is that a column of molten metal 1 inch square and 4 inches high exerts a pressure of 1 pound on the bottom surface, or, in other words, a pressure of 1 pound per square inch of mold surface for every 4 inches of height. For example, the total depth of the gate for a plain plate 12 inches square by 1 inch deep, molded in the bottom part and covered by a top box 4 inches deep, carrying a 2-inch runner bush, would be 6 inches, and the area of molten metal in contact with the top part would be 12 inches by 12 inches, or equal to 144 square inches. The pressure exerted by the metal in the 6 inches down gate would be 1½ pounds per square inch, equalling 1 pound for every four inches. The total lifting pressure would thus be 144 x 1½, or 216 pounds.

The question still further is complicated by the lifting pressure, due to the presence of cores. Iron weights approximately four times its own volume of sand, and therefore if a core weighs 20 pounds, it will displace 80 pounds of iron. The difference between these two weights will have to be added to the lifting pressure.

Mis-runs and cold-shuts are closely allied, although varying in appearance. Where a casting shows a distinct section which has not run up, the section having rounded edges, it is called a mis-run. A casting section showing a line where two streams of metal meet, but fail to unite, is known as cold-shut, although technically, it is a mis-run. Either may be caused by dull metal, small pouring gate, or bad pouring practice. Good castings never are made from dull metal, and no man is justified in casting with such metal. Workmen are too anxious to take a shank of metal because it happens to be their turn and produce scrap rather than wait for the next tap to get hotter metal.

Pouring Practice

Some men pour metal just as they pour beer from a bottle, dribbling it in, fearing to create a froth. On the other hand, others slop metal indiscriminately over the runner box, the floor and the feet of anyone standing near. The casting should be poured with decision, and an endeavor made to keep the basin just full. Some advocate large runners for gating aluminum, but they can be so large and the casting poured so rapidly, that a mis-run will result. Aluminum is rather a sluggish metal, quickly becoming pasty. Before a mold can be filled completely, every particle of air must be displaced. If the metal is poured rapidly and immediately comes up the risers, an air lock may take place in the mold. By the time this air has escaped through the

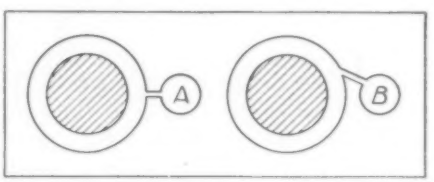


FIG. 3—IN *A* THE METAL STRIKES DIRECTLY ON THE CORE AND HAS A TENDENCY TO WASH SOME OF THE SAND AWAY—IN *B* THE METAL ENTERS THE MOLD AT A TANGENT AND DOES NOT CREATE A DISTURBANCE

sand, the surrounding edges of aluminum have set, thereby producing a mis-run.

Dealing next with cold shots, as distinct from cold shuts, Mr. Hurren said these are indicated by the presence of small round pellets embedded in the mass of metal, but easily detachable. They are some times caused by the pourer dropping a few drops of metal into the gate from the lip of the ladle. These drops break up into small pellets, and the metal poured later may not completely dissolve them. Another explanation may be that when a runner is rather deep and the metal has a long drop, the first metal becomes scattered. Cold shots also may be caused by a miniature blow, due to the hot metal meeting with a slightly damp spot of sand, and so generating steam which bubbles through the molten metal, causing the formation of shot, which, as a rule, show up during machining operations.

Scabbing and Blowing.

Crushes are a vexing form of scrap, easily avoidable by care on the part of the molder. When a box part is tried on, an examination of the mold should show any evidence of a crush. This class of scrap clearly is due to negligence.

Scabbing is a common trouble with which everyone probably is familiar. It is caused by a piece of the mold or core becoming detached and leaving an unsightly mark or patch on the casting. In addition, the detached sand is floated away and either comes to anchor as a solid lump in some other part of the casting or is broken up into small particles which show up as dirt on machining. Scabs may be caused by hard ramming, damp spots, or insufficient venting, but in either case the effect is the same. It is essential that the generated gases escape freely through the sand, and if they are unable to do this, they pass through the metal, causing slight agitation and detach the sand from the mold. In sand molds unevenly wetted, the contact of the hot metal with a damp patch generates an excessive volume of steam, causing portions of the sand mold to be broken away, while a violent agitation of the metal causes a blow.

Blowing is a prolific scrap producer, often attended by danger to the workers, and unusual quantities of gas may be forced through the metal in such a way as to violently eject quantities of molten metal. The speaker stated he had seen cores in molds with plenty of internal vents, but only a small exit. He could see no reason in putting four or five ⅛-inch vents in a core, but all leading into a ⅛-inch exit. Congestion of gases was bound to occur at the most vital time. Coremakers are inclined to pay rather less attention to venting than are the molders. Blowholes might be due to gases in the metal, particularly with steel castings. As a general rule, blowholes due to the mold are brightly colored, while those due to gases in the metal are clean and colorless.

Blowing may be caused by metal getting in the vents, thus preventing a preescape of gas, and in many instances, blows are shown to be due to cores fitting rather loosely in the prints and the gap between not being filled with sand, oil and blacking, or some other form of stopping. Molders have been in the habit of rubbing cores whether it is necessary or not, and if the vent happens to be quite near the surface, this rubbing may cause the skin of sand covering the vent, to become so thin as to burst under the force of metal, and cause a blow. If cores were not carefully pasted together, metal would penetrate between them and enter the vents. Scrap causd by blowing called for close investigation, because such things were apt to become chronic.

Cross jointed or overshot castings usually are caused by ill-fitting box pins. This is a matter for the foreman, although the speaker had known cases of men working with loose pin boxes using a pair of ¾-inch pins, instead of the ⅞-inch pins supplied, because the smaller was an easier fit. Where loose pin boxes have to be weighted or cottered, this should be done before the loose pins are removed, otherwise a cross jointed casting may result. In machine molding, scrap might be produced by the operator putting his top part on wrong way round with sometimes curious results.

Cores large in area are likely to lift, especially where the prints are short and this produces a casting thick on the bottom side and thin or cut through on the top. Often the only remedy is the use of chaplets which require to be placed carefully. In motor cylinder work it is necessary to tie cores down with copper or iron wire, and the molder must be careful in doing this to insure that metal does not reach the wires. A few drops of metal are sufficient to fuse copper wire, thus freeing the core with fatal results to the castings.

Contraction Problems

Contraction cracks do not occur so frequently in cast iron as in malleable and aluminum castings. With the latter, it often is necessary, as soon as the metal has set to ease the tension, by digging out the cores and removing the grids, but this is a delicate job, calling for nice judgment, as aluminum at one stage is pasty and easily broken. Particular attention should be given to the method of gating, as the part of the casting nearest the gate usually is the last to solidify. It may be that the still liquid metal is pulling at the part already set, causing a crack. An alteration in the method of running often will effect a cure. Broken cores are not so common, and when they occur, are most frequently cracked by the molder when placing or tying them in position. Tying down cores is an operation calling for care and judgment. Usually the cores are cracked in handling and the force of metal causes a portion to become detached.

Strain or swell, due to soft ramming, which, though not always producing scrap, makes the casting unsightly. The remedy is simple and obvious.

Dirty Castings

The presence of dirt or slag in castings is common cause of scrap, often difficult to overcome. Molders generally cut their down gates with a tube, which always leaves ragged edges of sand. If they omit to run their cleaner or finger round to wipe off these ragged edges, the first entry of metal washes away this loose sand and carries it into the mold. Further, men sometimes would rather stand five minutes at the furnace for a shank of metal than five seconds to have the metal skimmed. When metal and slag are poured into the mold, indiscriminately, it is no wonder that the casting is rejected. Much of the scrap caused by dirt is due to the size and shape of the runner. The area of the pouring gate should be greater than the area of the gate at its junction with the casting.

For most malleable castings and some of cast iron, a *spinner* is used. The speaker illustrated by a drawing, what he considered the correct form of spinner, in which the metal passes round imparting a rotary motion which retains the dirt in the center, while the casting is fed from the outside edge. Sometimes a runner is so placed that the incoming steam of metal plays directly onto a core or a portion of the mold. The sand on which the metal impinges is thereby cut away, producing a dirty casting. This usually may be remedied by making the runner tangential, as in the illustration.

The size and shape of runners is well worthy of study, and it should always be remembered that however well a runner may be placed, unless every portion from the runner bush to the casting is kept filled with metal, there is a risk of producing dirty castings. This can not be accomplished unless the total area of the ingates is less than the area of the pouring gate.

The question of sponginess might be one for the foreman to take in hand. Spongy places usually occur at the joining of thick and thin sections. Remedies worth trying are alterations in position of size of runner, variations in the casting temperature, or the use of risers or chills. Porosity, a similar

trouble, may be similarly cured, but a change in the composition of the metal might be necessary.

Hard spots often are caused by the sand in the molds being unevenly damped down, and sometimes through irregular venting. In annealed malleable castings they frequently occur at the points where the runner or riser has been removed and are caused during grinding. If the grinder leans heavily on his emery wheel, the casting becomes hot, and the patch which has been ground reverts nearly to its stated hardness noted before annealing. This usually is indicated by a blue appearance on the ground portion. More care and less strength in the arm will practically eliminate the trouble.

Segregation occurs more with aluminum alloys than with gunmetals. The speaker stated he has seen aluminum castings with a satisfactory appearance in the top side, but a portion of the bottom side was a mass of needle-like crystals. The trouble was due to the fact that although the alloy had been melted satisfactorily, it was not sufficiently stirred, and a portion of the zinc had settled in the bottom of the crucible. He knew a case where there was 12 per cent of zinc in the top part, and 27 per cent in the affected portion of the bottom part. That showed the necessity of thorough stirring before casting aluminum or gunmetal alloys.

In conclusion, Mr. Hurren urged every foundry worker to take a more keen personal interest in his work, and endeavor by his reasoning powers, to find a remedy for scrap castings. Some men never made suggestions, preferring to put all the responsibility on the man in charge, which is a short-sighted policy. No scrap casting should be re-melted until it has been examined thoroughly and the reason for failure discovered.

In the subsequent discussion, Mr. Owbridge said that instead of using flask weights, he held the flasks down by clips. By the use of sulphur tablets, he secured great success until he found his castings becoming too soft and had to raise the sulphur content.

Another speaker stated he had found it necessary to prevent segregation by stirring the metal, not only in the furnace, but in the pouring ladle. Judicious placing of feeders was necessary to prevent porosity, and it was a mistake to use a large number of chills before trying the feeders.

After further discussion, Mr. Hurren replied on the various points raised. Malleable castings sometimes fail during annealing, owing to the metal in the hard state being highly crystalline. There always is a line of weakness through the crystal boundaries, where a sharp angle occurs or a thick and thin section join, and in annealing the heat causes unequal expansion, resulting in cracking. The speaker does not worry about sulphur up to 0.16 per cent, and he stated he had made cylinder castings 13 years ago for motor car engines with phosphorus as high as 1.45 per cent, and many of these still were doing good work.

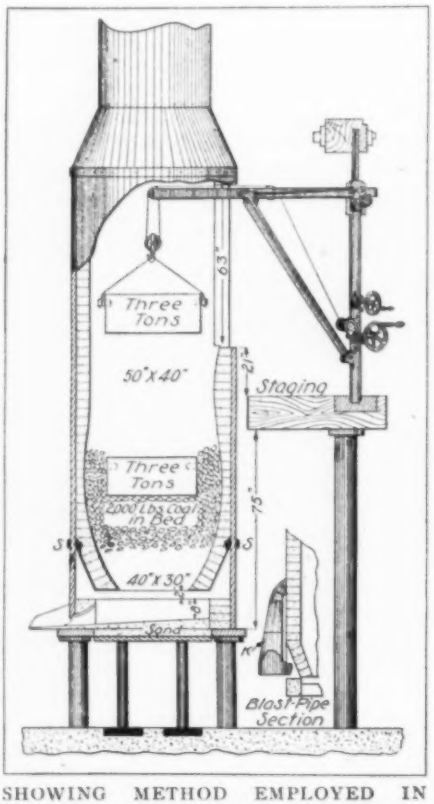
Where Heavy Scrap Was Melted in Cupola

BY JOB GOOSTRAY

IN READING "Bill's" description in the Feb. 1 issue of THE FOUNDRY of how he melted some heavy scrap in the cupola I was reminded of a somewhat similar occurrence which took place in the Pratt & Whitney Company's foundry, Hartford, Conn., back in the early 80's. The story appeared in the *American Machinist* at the time and afterward was published in Thomas D. West's "Molder's Text Book." Mr. West used the incident to illustrate his contention that anthracite coal was a better melting medium than coke and that a mixture of the two was to be preferred to the use of coke alone.

Quoting from the chapter "Coke and Coal In Melting Iron" Mr. West writes:

We have noted some of the quantities in which coal is superior, but there is one more that can be added; viz, its ability to melt heavy blocks of scrap iron. The benefit of coal in this respect could not be better shown than by melting a 3-ton block accomplished by the Pratt & Whitney Co., Hartford, Conn. Having read some time since, of this firm melting a 6000-pound block of iron, I thought at the time a mistake had been made by adding a cipher. As the article did not describe how it was done, or any of the details, there was nothing to figure from; so to insure that it was correct, I made it my business during my last tour to pay this firm a visit. In talking with Mr. Gardner, the foundry foreman upon the subject, he said it was a fact and took me out to the yard where there was a duplicate of the 6000-pound piece he had melted. I told him I thought he had melted the heaviest piece that had ever been charged in a cupola of this size and asked his permission to describe the melting at length, as it was a creditable job and would interest many foundrymen.



SHOWING METHOD EMPLOYED IN CHARGING AND MELTING A 3-TON BLOCK

The cupola used was a Mackenzie, the size being as shown in the accompanying illustration. The process of melting was as follows: For bed 2000 pounds of coal, on which was placed the 3-ton block. Around this was placed 400 pounds of coal and the fire started. After it was well going the cupola was charged to complete a heat of 22,000 pounds by having four charges of 500 pounds of coal and 4000 pounds of scrap and pig in each charge. The first 500 pounds of coal was placed upon the 6000-pound block thereby burying the block in 2900 pounds of coal. The metal was used to pour a similar block and a class of work which had the metal been dull, the castings would have run full. Although this class of work was selected, Mr. Gardner said the metal would have run lighter work.

The fuel used for the above heat was 1 to 5, this percentage being necessary by the requirements of an extra weight of fuel for the bed. For ordinary heats the bed is 1500 pounds of coal, with the charges the same as used with the block; so that for an ordinary heat of 22,000 pounds the fuel would be 1 to 6.28. When this block was charged the cupola was well burnt out. Had it not been, Mr. Gardner said he could not have melted the block as there would not have been room to properly bed it. For the purpose of admitting this block the charging door was removed and enlarged so as to make it about the height shown. The jib of the crane is racked out by the upper handle and the load let down by the handle shown immediately below. The illustration shows the block suspended ready to be lowered down to its bed; also when it is bedded in place.

Specialty Shop Shows Versatility

From Minute Stove Parts to Largest Malleable Castings Are Made—Mold for the Latter Made in Green Sand from a Pattern and Core Box

SOME conception of the number of stoves made in the United States may be gained from a statement recently published to the effect that in 1920 the five leading stove foundries in the city of Detroit, alone, produced 600,000 heating units valued at $15,000,000. Stove founding is a highly specialized branch of the foundry industry with problems and methods peculiar to itself and depending usually upon highly skilled men for its successful prosecution. The castings must be true and accurate to facilitate assembling the various parts; they must be held within rigid and definite limits in weight; finally, since many of the parts are either nickel plated or polished, they must be absolutely clean and smooth.

As the stove casting industry supports a great number of foundries which make nothing else, these shops in turn furnish a considerable tonnage of accessories handled in some of the so called light work shops. The stove shops concentrate on the manufacture of the main component parts of the stove. They do not as a rule make the hundred and one little parts which go to make up the complete stove. Door knobs, handles, catches, nuts, grates and burners, ornaments, etc., are made in immense quantities by foundries equipped in a special manner for taking care of these and similar castings. One such shop is the Fanner Mfg. Co., Cleveland, which issues a catalog wherein are listed over 500 small standard parts. The business of this company may be divided approximately into two general classes. About 75 per cent of the production is devoted to keeping the catalog stock replenished and the remaining 25 per cent is outside work which conforms in a general way to the prevailing class of work handled in the plant.

Two Malleable Furnaces

Long jobs are the rule rather than the exception. Some patterns remain in the sand practically from one year's end to the other. Others again, run for months at a time and few orders are booked for less than 1000 pieces. An exception to the general rule is found in the case of some of the camparatively heavy castings made both in gray and malleable iron. One of these, shown in Fig. 1, will be described later.

A considerable part of the company's manufactured product consists of sheet iron and fabricated wire goods including standard and special shapes in perforated chaplets. A battery of 100 wet mills is employed for preparing the castings and other products for one of the largest nickle plating plants in the country. However these features will not be touched upon in this article.

The foundry building is 400 feet long by 160 feet wide and is equipped with one 60-inch cupola and two 8-ton air furnaces for the production of both gray iron and malleable iron castings. Under normal conditions, the cupola melts about 15 tons a day, while two heats are taken out of each of the malleable furnaces in the same time. As originally planned, the cupola and one of the air furnaces were located on a line drawn through the center of the building and about 40 feet respectively from each end. The second air furnace was added later and was placed about midway between the other two.

The melting units form a natural division down the center of the shop and occupy a considerable amount of floor space. This is particularly true of the air furnaces. The cupola is situated in the open. There is no wall around it and with the exception of the space immediately behind which is occupied by the blower and motor, molds are made right up close to the cupola on each side. All the iron is caught in hand ladles and therefore a gangway passes

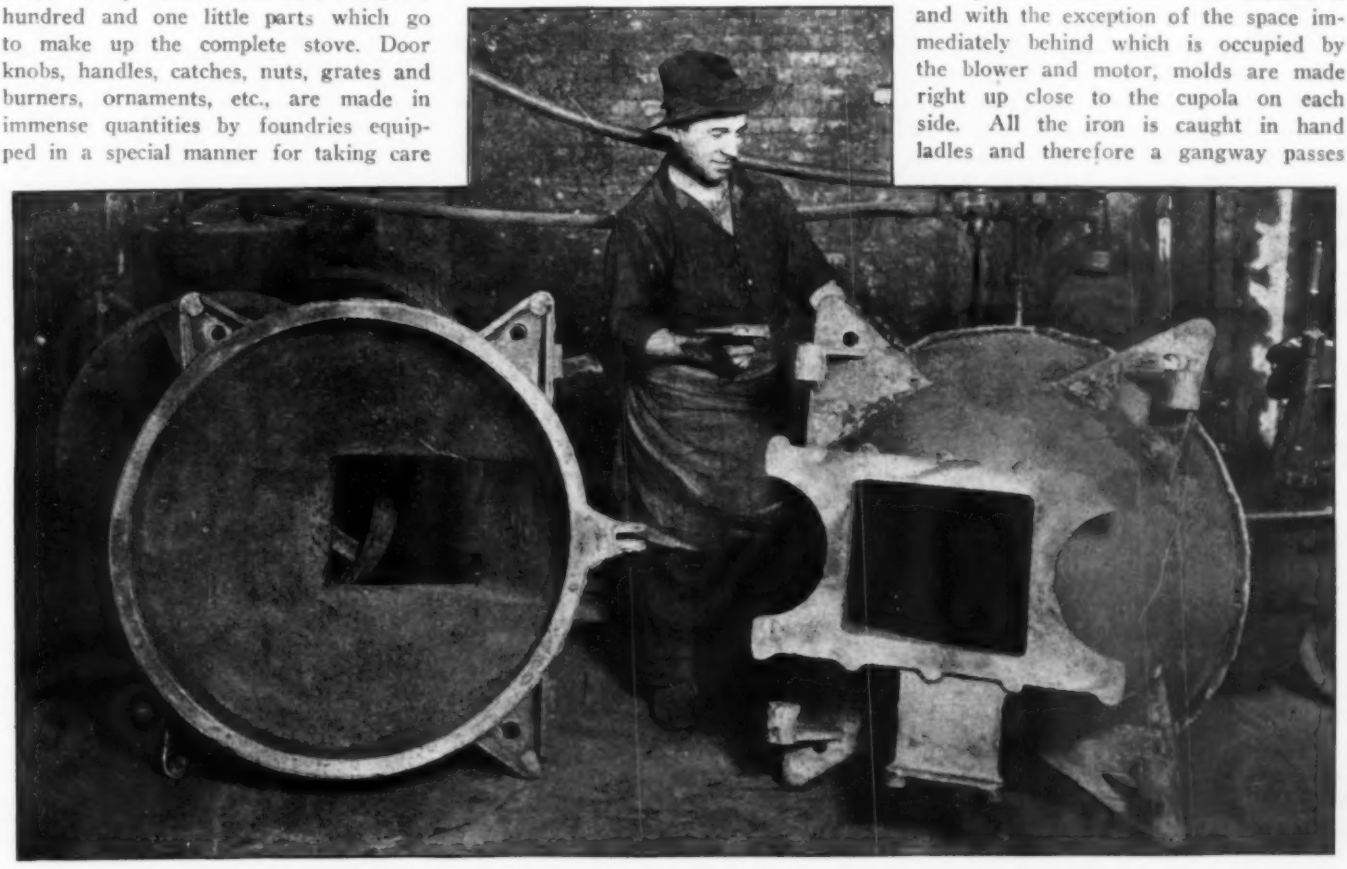


FIG. 1—FRONT AND BACK VIEW OF LARGE, INTRICATE MALLEABLE IRON CASTING BEFORE ANNEALING

FIG. 2—OPEN COKE FIRE FOR DRYING THE HAND LADLES

in front of the spout and extends from the end of the building to the center one of the two air furnaces.

Two main gangways located about 30 feet from and paralleling the side walls of the building serve to divide the shop into four sections. As stated before, the space occupied by the furnaces serve as a natural dividing line or neutral space in the center.

Many Molding Machines

The molding floors, approximately 150 in number, extend at right angles from the two sides of the two main gangways. Each floor is equipped with a plain, hand-power, squeezing machine. Practically all the patterns are mounted on match plates and on account of the light metal section of most of the castings it is not necessary to use either bands or slip jackets on the snap flask molds employed. They simply are weighted and poured. Another curious feature in connection with some of the castings poured in this shop is that frequently the sprue and gates weigh several times the combined weight of all the castings in the mold. This is particularly true in the malleable iron section, where the analysis of the iron is held to a definite standard. The amount of sprue and gate that can be remelted is determined by this analysis and ordinarily the work on the floor is of such a character that all this scrap can be absorbed day by day.

However, occasionally on account of a continued run of extremely light work, the sprue and gates cannot be used; but are stacked in a pile at the end of the shop and kept until the character of the work warrants their use again. The air furnaces are fired in the usual way by hand with soft coal. Each furnace terminates in a high stack which furnishes a natural draft and in addition a fan supplies forced draft at the firing end. One branch from the blast main discharges into an air tight chamber under the fire bars and another sub-divided into several small branches discharges jets of air into the top of the furnace directly above and in front of the bridge wall. A large hood, connected to a pipe leading to the roof is suspended over the firing door of each furnace and serves to remove the smoke and fumes incident to firing.

Pig iron and scrap constituting the charge for the air furnace are weighed outside and loaded into steel plate dumping buckets. The total amount for a second charge is made up and left standing along side the furnace while the first charge is melting down. After the first heat has been tapped the bungs are lifted off the roof and the steel buckets containing the material for the next charge are lifted by a crane provided for that purpose and dumped on the furnace hearth. The bungs then are replaced and the melting process is repeated.

Large Malleable Casting

The two large and intricate malleable iron castings shown in Fig. 1 stand out in distinct contrast to the great bulk of the castings made in this foundry. They form part of an order of 50 recently completed by the company for an outside interest. The casting is 4 feet in diameter and weighs 538 pounds. The method adopted for producing this casting is shown in Figs. 5 and 6. The metal thickness is only ¾-inch and for that reason it was not considered advisable to make a pattern the exact duplicate of the casting inside and out. Such a pattern would be too light

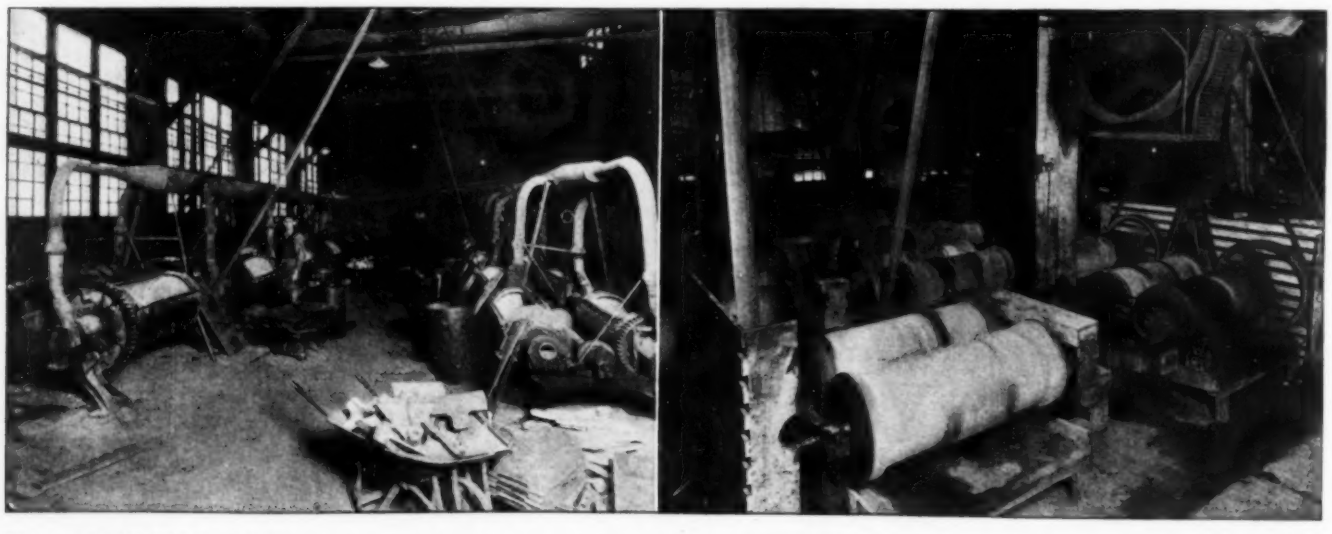


FIG. 3—GRAY IRON CASTINGS ARE TUMBLED IN ONE BATTERY OF TUMBLING BARRELS WHILE THE HARD MALLEABLE CASTINGS ARE TUMBLED IN THE OTHER FIG. 4—CASTINGS TO BE PLATED ARE WATER-ROLLED FOR A PERIOD OF FOUR DAYS IN THIS ROOM WHICH CONTAINS 100 MILLS

TIPPING GEAR FOR A 30-TON LADLE

By Hugh Scott

The tipping mechanism for controlling the flow of iron from a 30-ton foundry ladle is shown in the illustration, Data Sheet No. 376. The figures shown on the drawing and also on the list of materials are those for parts in actual use at the present time on a ladle of this size and capacity. However, they may be adapted easily to suit a similar mechanism designed for use with crane ladles of either greater or less capacity. The material lists follow:

LIST OF MATERIALS

No. Wanted	Name	Material
1	Gear Wheel	C. I.
1	Pinion Wheel	Gun Metal
1	Gear Wheel	C. I.
1	Hand Wheel 25" Dia.	C. I.
1	Bracket	C. I.
4	Caps	C. I.
1	Spindle 1¼ x 17 inch Journal 1⅛" x 2⅛"	Ma. St.
1	Spindle 1¼" x 11½ inch Heads 3" Dia. 1" Thick	" "
1	Spindle 1¼" x 3½ inch Head 3" Dia. 1 Thick	" "
2	Teeth ⅝" x 4 11-16 inches.	" "
1	Dog Wheel 4 inch Dia. ⅝ inch Thick.	" "
1	Dog	" "
1	Key 1 x ⅝" x 6 inches	Ma. St.
2	Keys ⅜ x ⅜" x 3½ inches.	Ma. St.
1	Key ⅜" x ⅜ x 1¼ inches.	Ma. St.
1	Key ⅜" x ⅜" x 2 inches.	Ma. St.

LIST OF BOLTS & NUTS

No. Wanted	Dia. R	Length	Grip	Materials	Remarks
4	1 inch	7⅛ inches	6 inches	W. 1	Hexn Heads & Nuts
3	⅝ inch	2⅝ inches	1⅛ inches	W. 1	" " "
1	⅝ inch	6½ inches	5⅛ inches	W. 1	" " "
1	⅝ inch	2 inches	1⅛ inches	W. 1	" " "
4	⅝ inch	2⅛ inches	1⅛ inches	W. 1	" " "

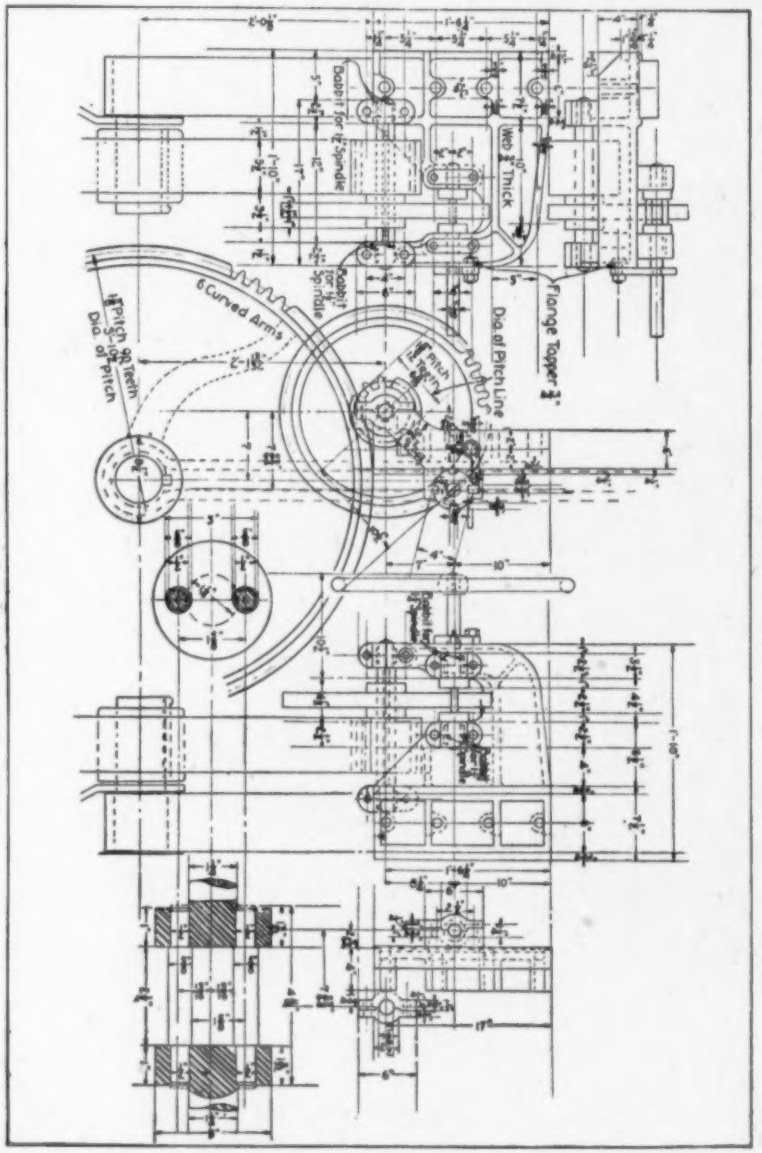
The gearing is arranged in ratio to allow steady, but not too rapid tipping. A 25-inch diameter, cast-iron, hand wheel is attached to a spindle having two lantern teeth which engage suitable teeth on a wheel 21 inches in diameter. This second wheel in turn is mounted on a shaft with a gun metal pinion 6 3/16 inches pitch diameter, 12 teeth, 1⅝ pitch. The pinion meshes with a spur gear keyed to one of the trunnions of the ladle. As may be seen from the illustration, the gear is 3 feet 10½ inches in diameter on the pitch line, and has 90 teeth, 1⅝ pitch.

All the gearing with the exception of the large spur gear is mounted in a heavily ribbed cast iron bracket which in turn is firmly bolted to one of the upright standards of the ladle bail. The dog wheel and dog shown provide a factor of safety and prevent the ladle from tipping when no one is holding the wheel.

(*Concluded on Data Sheet No. 376*)

Note—This sheet may be cut into two sections, 8 x 7 inches, and may be readily bound in note book form.

TIPPING GEAR FOR A 30-TON LADLE



DETAILS OF TIPPING GEAR OF A 30-TON LADLE

THE FOUNDRY DATA SHEET, APRIL 1, 1921

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

and flimsy and would inevitably warp out of shape.

A metal pattern would have been the logical form to adopt and probably would have been used if the size or extent of the order warranted. However, for 50 castings the cost of a metal pattern was considered excessive and the method illustrated in Figs. 5 and 6 was adopted. As will be noted in the illustration practically two patterns were constructed, one to form the outside of the mold and the other to form the inside. In addition to these a right and left hand corebox was provided for making the dry sand bracket cores *A A* Fig. 6 and another for making the dry sand lug cores *B B* Fig 5.

The mold was made in a 4-part flask, a drag, two cheeks and a cope. The partings in the mold were made at the points indicated by *C*, *D*, and *E* Fig. 5.

To bring the assembled flask to a convenient height for pouring with four bull ladles it was decided to dig a hole in the foundry floor and sink the drag flush with the floor. Here it was carefully leveled and the sand shoveled all around it and rammed into place. Setting the drag permanently and definitely in this way for the first casting saved considerable work on each subsequent mold that was made. It will be apparent, that by having an approximately level bed to start with each time, the operation of setting the pattern would be reduced to a minimum.

The bottom of the drag was filled with coke connecting with suitable openings provided between the drag and the bottom board after which the drag was filled with sand and rammed flush with the top or joint. A straight edge with a ¾-inch step at each end was employed to sweep a foundation on which to set the pattern. A level was tried on the top flange of the pattern and the necessary minor adjustments made to insure that the pattern was resting perfectly level. This precaution was taken for various reasons but principally as a check or gage by which the corebox could be lined up later on to insure an even metal thickness on the side walls of the casting. Sand was then shoveled around the lower flange of the pattern and rammed firmly to withstand the pressure of the metal incident to pouring, after which a flat parting was made.

The first cheek then was put on and rammed full of sand. A parting was made all around at the line indicated

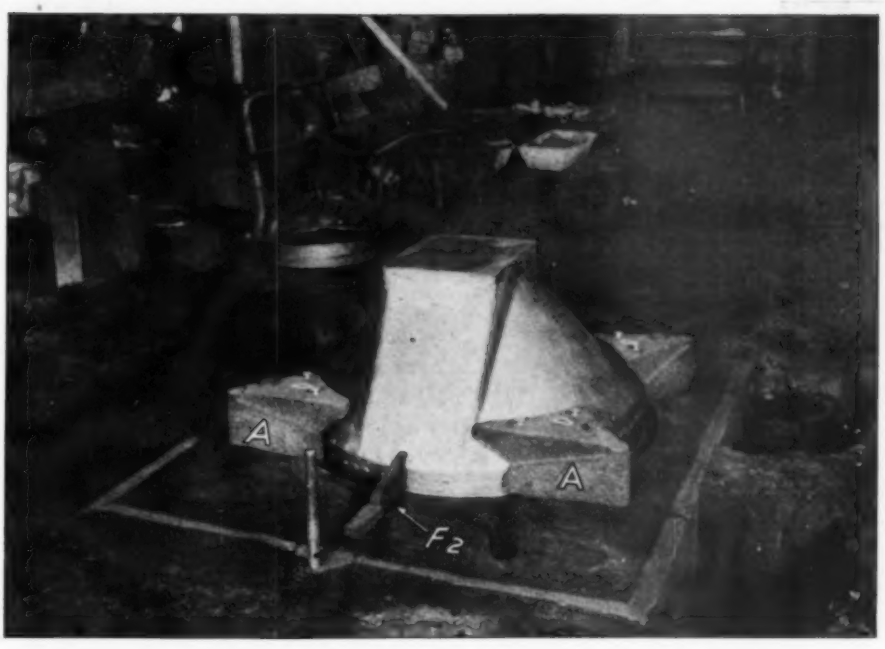


FIG. 6—DRAG MOLD WITH GREEN SAND CORE BUILT UP AND FOUR DRY SAND BRACKET CORES IN PLACE

FIG. 5—COREBOX AND PATTERN EMPLOYED FOR MAKING THE MOLD

FIG. 7—PIG IRON AND COKE ARE PILED ON BOTH SIDES OF A SPUR FROM THE MAIN LINE BETWEEN THE FOUNDRY AND THE BUILDING HOUSING THE CLEANING AND ANNEALING ROOM

at *D* Fig. 5. The second cheek provided with suitable chucks for carrying the sand was set on next, rammed full of sand and a parting was made flush with the top surface of the upper flange. The cope was plain and flat. Four gate pins were set while ramming, two at diagonally opposite corners designed to connect with the bottom flange and two others at the remaining corners on the top joint. Each gate was connected to the mold opening by two branch gates. One of the bottom gates is shown cut in the drag Fig. 6.

Making the Core

To remove the pattern from the mold, the cope was lifted off and set on one edge on blocks. Two long clamps having one end resting on the floor and the other end against the upper edge of the cope prevented it from falling over. The rectangular flange with the attached brackets was then drawn out of the sand after which the upper cheek was lifted off and set on a pair of horses. While in this position the four square core prints, two of which are indicated at *B B* Fig. 5 were removed and replaced by the cores provided for that purpose. By referring to Fig. 1 it will be seen that the bosses and brackets made by these cores are right and left hand. All the cores were made from one box by adopting the simple expedient of providing two loose pieces in the box. To obviate the danger of setting a right hand core in a left hand print or vice versa each core print was provided with a triangular gap at the bottom of one corner as shown at *J* Fig. 5. A similar piece cut out of the print side of each core and at the proper corresponding corner insured that the cores would be set in their proper relative positions.

The next step was to set the upper cheek back in its place, shift the lifting chains to the handles of the lower cheek and lift them both together and set them on the horses. The pattern was then drawn out of the drag and set aside. To form the inside part of the mold the corebox shown at *K* Fig. 5 was employed. This corebox was made of wood, heavy and rigid and turned accurately to conform to the inside shape of the casting. The lower flange was made to fit closely in the impression left by the pattern. The lug *F* on the corebox corresponded to the lug *F*1 on the pattern and was a guarantee that the rectangular section of the core would come in its proper relative position when the mold was assembled.

The corebox was set on the drag as indicated and tried with a level to correct any minor irregularities. It then was rammed full of sand, rapped, lifted off and set aside. The inside and outside of the mold were finished carefully, nailed wherever necessary and brushed with plumbago. After setting the four bracket cores *A A* Fig. 6 the mold was reassembled, clamped and poured. Each one required a molder's full time for four days.

To anneal the large castings the special square frames shown in the corner of the oven Fig. 9 were cast. An iron bottom plate was placed on several rows of bricks built two-high. The casting was then run in on the charging car and set on the plate after which the frames were placed around it and packed full of roll scale.

Cleaning Facilities Extensive

The gray iron and malleable iron castings are all cleaned in the same building in two batteries of tumbling barrels made by the W. W. Sly Mfg. Co., Cleveland. They are provided with dust arresters and arranged in groups as shown in Fig. 3. The cans, shown in the gangway in the same illustration are employed for transporting the castings from place to place and also to keep the different varieties of castings separated.

After the castings have been tumbled a sufficient length of time, those made

FIG. 8—THE CASTINGS AND PACKING MATERIAL COMPRISING THE CONTENTS OF THE ANNEALING POTS ARE DUMPED IN ONE PILE—THE CASTINGS ARE FORKED OUT AND TAKEN TO THE SOFT TUMBLING BARRELS

of gray iron are unloaded from the mills into cans and taken to a battery of small double stand grinding wheels located close by. On starting to work, each of the grinder operators is provided with an empty can on one side and a full can on the other. He picks the castings out of the full can, does the necessary grinding and drops them in the empty can. From the grinders the castings are sent either to the shipping platform, to the stock room or to the plating room, depending on their ultimate destination.

Those that are sent to the shipping room are shipped immediately. Those that go to the stock room usually are integral parts of some device which require other parts to be added before it is shipped. Those that are sent to the plating room are first *water-rolled* for four days in the battery of wet mills shown partly in Fig. 4. Pieces of sand stone which have been put through a small stone crusher are packed in the wet mills along with the castings. This process furnishes castings that are scoured perfectly clean, a condition essential to successful plating.

Annealing Ovens

The malleable iron castings are taken from the tumbling barrels and placed in the annealing ovens. The general features of one of five similar ovens is shown in Fig. 9. The fire place discharges its heat close to the roof while the row of open ports along both side walls at the level of the floor conduct the heat under the floor to a point near the door. Here it enters a long straight flue leading to back of oven and discharging into a common flue connecting the entire battery of ovens with the stack. The ovens are fired at the back with soft coal. Individual dampers are provided by which it is possible to control the temperature of each oven while in use and also to shut it off from connection with the stack when not in use. In the ordinary routine, the annealing process lasts a week. That is, castings that are placed in the oven one day are removed the same day a week later.

After they have been taken out of the tumbling barrels, the castings are chipped and ground if necessary and then are divided into two general classes. Those that are to be shipped as ordinary malleable castings are weighed and packed for shipment, most of them in bags, while those that are to be plated are taken to the wet-mill room and water-rolled. Before passing from the annealing ovens, two features seem worthy of mention. For convenience in handling, the doors are made in two halves and when in use the vertical joint is daubed with mud. Each part of the door is made up of an open malleable iron frame filled with brick. A crane runway extends the full length in front of the battery of ovens. A light, hand-operated crane, having an 8-foot span and supporting a trolley from which a chain block is suspended, furnishes an easy and convenient method of handling the doors. It will be noted that the doors are not attached to the door frames by hinges or in any other manner, and therefore any distortion does not interfere with their functioning. When not in use they are out of the way. They also are interchangeable and no time is lost when it becomes necessary to repair one of them. When in use, the door is placed up against the front of the oven by the crane. A strand of wire is twisted around the lug on the door and a corresponding lug on the upper part of the door frame after which the crane is removed and the joint between the door and frame daubed with mud.

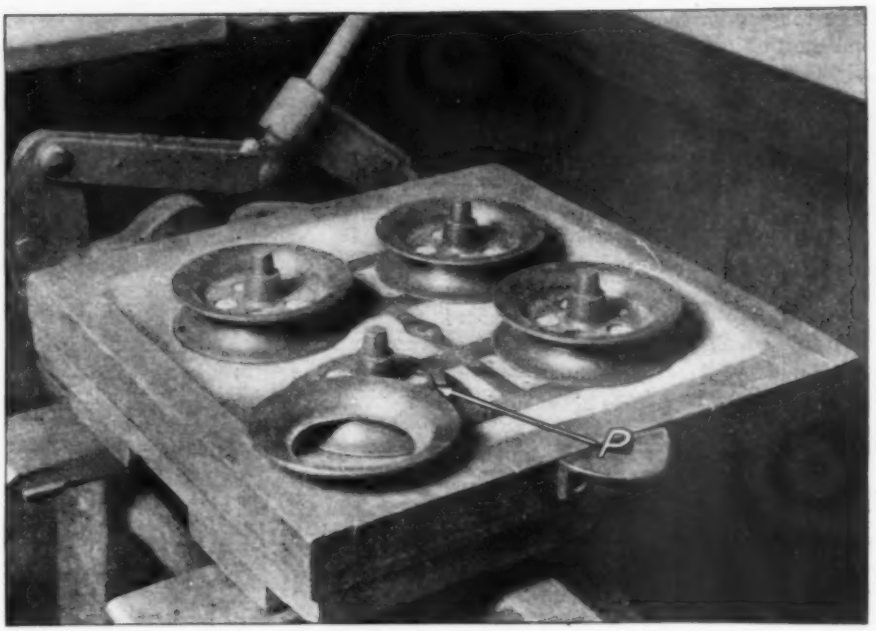


FIG. 10—TYPICAL RIG FOR MAKING SMALL SHEAVES IN A 2-PART SNAP FLASK

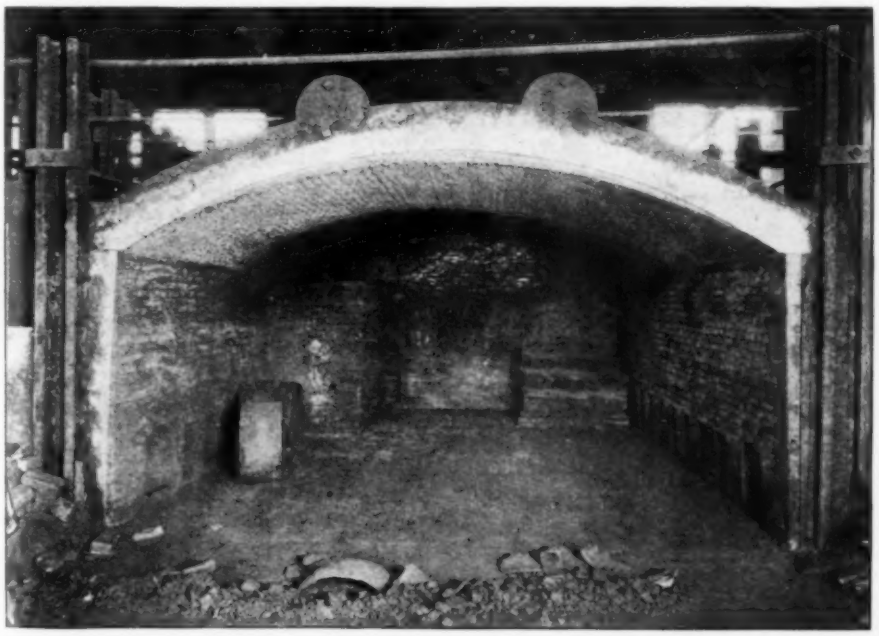


FIG. 9—ONE OF THE ANNEALING OVENS SHOWING THE FIRE PLACE AND THE PORTS CONNECTING WITH THE FLUES

Stove Plate Sand

On account of the small and intricate nature of most of the work, a fine grade of stove plate sand is employed for making the molds both for the malleable iron and gray iron castings. One of the results of using this sand is a fine finish on the face of the castings. This is particularly noticeable in the gray iron section where the average weight of the castings is greater than in the malleable iron section. At the time this article was written several floors

were running on sheaves of various sizes and the finished castings were exceptionally fine.

All the sheaves are made in snap flasks from patterns mounted on plaster match-plates. In the larger sizes, the patterns are mounted singly but in the smaller sizes, several patterns are grouped to go in one flask. A typical match plate and set of four patterns is shown in Fig. 10. The patterns are made of white metal carefully turned and finished all over parted in the center and fitted together by means of a male and female joint as indicated at *P* Fig 10.

To make a mold with this rigging, the flask has to be turned over twice and as the operation is a little out of the ordinary it will be described briefly in detail. Having adjusted the four ring patterns and runner in place, sand is riddled on and tucked into the grooves of the patterns and afterward all over the match plate. The superfluous sand then is scraped off flush with the top rim of the patterns and sloped down to the match plate on all four sides. This parting is brushed off clean and covered with parting compound. The *cope* half of the snap flask is then put on, rammed full of sand and both flask and match plate rolled over. The match plate is removed, parting compound sprinkled on the upturned face of the mold after which the *drag* half of the snap flask is set on, rammed full of sand and lifted off. The four top halves of the patterns together with the connecting gate are drawn out of the sand, after which the drag is replaced and both halves of the mold rolled over. The cope is now in its proper relative position and is lifted off after which the four remaining halves of the patterns are drawn out of the sand. After setting the center cores, the mold is closed and the snap flask removed. In foundry parlance the process is known as making a 3-part job in 2-part flask which is rolled over twice.

Pointers on Gas-Fired Crucible Melting

INTERESTING information on the installation and operating cost figures for gas-fired brass furnaces were presented by A. L. Palmer, Consolidated Gas Co., New York, at a recent meeting of the American Gas association. Mr. Palmer, who is in close touch with brass foundries in New York, states that there are about ninety furnaces, ranging from 50-pound to 1000-pound capacity in the vicinity which utilize gas for fuel. The writer emphasizes the need for care in installing gas-burning equipment and outlines the following points to be observed.

Gas Supply. Provide piping and meters to supply without extreme pressure drop, 30 per cent more gas than it is expected to use and carry this pipe full size, with shut-off cock, to within a foot of the burner before reducing to fit the burner connection.

Burner Pipe. Avoid long burner pipes, from fan to nozzle—10 feet is all that should be allowed. Also avoid sharp bends in burner pipe. Use 45 degree bends where necessary but use straight run if in any way possible.

Burner Nozzle. See that the angle of the nozzle is such that the flame is midway between the crucible and the furnace wall. If it strikes the crucible immediately it will quickly burn out the crucible and lengthen the time of melt. If it impinges or scrubs along the furnace wall near the nozzle it will cause the nozzle to burn away in a few heats. See that the end of the nozzle is kept back of the inner face of the lining about ¾ inch and that it is covered or mudded in with the best high temperature cement that can be obtained.

Electrical Connections. Make sure the characteristics of the motor correspond with those of the current supplied. Also discourage connection to such circuits as are subject to frequent and unexpected breakdowns, severe voltage fluctuations or are used as signal systems by flashing off and on. Urgent service calls are liable to come in if these are neglected.

Motor Troubles. Use only ball-bearing motors in a foundry. See that they are covered to protect from heat and as much dirt as possible. Next to nozzles (improperly taken care of) it was found that motors cause the most trouble.

Ventilation. If the furnace room is small or has a low ceiling, or yellow brass is to be melted, insist on the installation of a hood with a strong natural or artificial draft connection. This is necessary to remove metal fumes, heat and the products of combustion which will, at times, contain a slight percentage of CO. It is preferable to have either a large stationary hood or a small round one, with a slip joint in the vertical flue connection, so that it may be lowered over the furnace during the latter or smoky part of the run and raised out of the way during the charging and drawing of the crucible.

Inspection Recommended

After the completion of the installation, there should be maintained a system of regular, periodic inspection. For the first few months, this should be done at least monthly. Later, the inspections can be made every two months. After the first few days of operating, a variety of troubles, both serious and unimportant, are likely to arise which can be easily remedied at the time but, if neglected will cause discouragement and likely the abandonment of gas fuel.

Mr. Palmer says:

"I have thus far, purposely kept away from the subject of converting coal or coke furnaces to gas. Furnaces can be converted and be made to work quite as satisfactorily as a new furnace but it requires a lot more work and time and is liable to be a mechanical make-shift. Moreover, the total cost in time and money will closely approximate that of a new furnace.

"The principal difficulty in making a conversion, is in arranging for a suitable cover lifting device. This is an important part of the installation and any of the devices now on the market require drilling of the shell and the removal of at least part of the firebrick lining. The other points to keep in mind particularly, are that the space around the crucible be no more than is necessary for tongs; that the distance from the top of the crucible to the cover be approximately one inch; and that the refractory lining be of the best possible quality."

Some interesting details of operation are offered by Mr. Palmer.

As a general basis, a heat an hour is the rated speed. Where production is the main factor, this can be speeded up by using a larger burner. In the average foundry, this will prove more than ample. In all cases, urge the management to readjust their routine so that the molds wait for the metal and not the reverse. For charging metal, insist that the lower part of a crucible, with the bottom removed, be used as a charging hopper. This or some other form of preheating can easily effect a fuel saving of 15 to 20 per cent.

When first starting up, adjust the burner so that a flame about four inches develops above the cover. This will produce a reducing atmosphere in the furnace, but, under most conditions, will not allow any appreciable amount of carbon monoxide to pass off in the flue product. In the majority of cases, run the burner at

full consumption or not at all. Running at fractional capacity, is false economy and will increase the time, metal loss and gas consumption.

Operating cost is a subject on which it is difficult to give definite information except for specific cases. In any particular foundry where the gas, metal, kind of castings and general foundry practice are known, a fairly accurate estimate of the fuel cost can be made. Based on practice with single chamber, crucible furnaces, on 600 B.t.u. gas, without recuperation or preheating, (except that of the metal in a charging hopper) Mr. Palmer gives consumption data of which the following are typical data:

TYPICAL CONSUMPTION TABLES

NO. 1

Foundry operating four gas furnaces, No. 35 and No. 45 crucibles, on medium weight castings of yellow brass and some high copper compositions—quantity production. Average of 11 heats (one furnace, one day) on yellow brass.

Time	40 min.
Metal	105 lbs.
Gas	327 cu. ft.
Gas per 100 lbs.	311 cu. ft.

Average of 25 heats (one furnace, four days) on composition.

Time	65 min.
Metal	135 lbs.
Gas	566 cu. ft.
Gas per 100 lbs.	420 cu. ft.

As high as 40 heats are obtained from crucibles on yellow brass.

With composition metals, the average life of crucibles at the foundry is 22 heats.

Average monthly consumption per furnace over a period of 14 months was 59,000 cubic feet.

NO. 2

Foundry producing ornamental bronze castings—small output—four heats per day.

No. of heat	Time min.	Gas cu. ft.	Metal lbs.	Gas per 100 lbs.
1st	64	550	130	423
2nd	50	500	120	416
3rd	50	450	127	354
4th	45	400	120	336

Average monthly gas consumption per furnace—62,000 cubic feet.

NO. 3

Jobbing foundry—six converted pit furnaces. Size of crucibles—No. 40, No. 60, No. 80 and No. 100.

Metal—Brass, bronze, government metal, copper and aluminum.

No. of heat	Gas cu. ft.	Metal lbs.	Gas per 100 lbs.	Composition of metal
1st	1050	245	428	88—10—2
2nd	950	249	381	88—10—2
3rd	950	207	356	88—10—2
4th	700	247	283	Yellow brass
5th	750	246	304	88—10—2
6th	700	264	265	88—10—2

Average for six heats—339 cubic feet gas per 100 pounds metal.

Average monthly gas consumption per furnace—65,000 cubic feet.

Average crucible life—21 heats.

NO. 4

Foundry department of concern making bronze name plates requiring very high pouring temperature on high copper bronze—virgin metal.

Equipment—Three converted oil furnaces.
Average size crucible—No. 35.
Average number of heats per day—Six.
Average pounds of metal per heat—100 lbs.
Average time per heat—57 minutes.
Average gas per 100 lbs. metal—460 cubic feet.
Average life of crucible—19 heats.

"The foregoing figures," says Mr. Palmer, "do not approach the results which are obtainable through refinements of furnace design whereby the enormous flue losses can be largely saved. However, it remains to be seen just how far such refinements can be carried and whether they do not secure increased efficiency at the expense of ultimate economy and production over an extended period."

Conveyor Co. Organizes

The Stearns Conveyor Co., Cleveland has been organized with a capital of $300,000. Earl D. Stearns, formerly vice president and sales manager of the H. K. Ferguson Co., Cleveland, and previously with the Link Belt Co., Stephens-Adamson Co. and the Fort Pitt Engineering Co., is president of the new organization. W. E. Philips, formerly with the Avery Manufacturing Co., the Westinghouse Electric Co. and the Stephens-Adamson Manufacturing Co., is vice president and shop superintendent. G. H. Whitham is secretary and treasurer. The company will manufacture elevating, conveying, screening and transmission machinery. A one-story factory building will be constructed by the H. K. Ferguson Co.

Different Impressions Conveyed by Tests

By George F. Comstock

In an article entitled "Meet Steel Castings Specifications" published in the Feb. 15 issue of THE FOUNDRY, E. R. Young comments upon the use of titanium as a deoxidizer and scavenger for steel castings. In support of his statements regarding the effects of titanium, a table of test results is given covering comparative tests on five heats. The writer's interest in this subject led him to study this table rather carefully, and a summary of Mr. Young's comparisons shown in the accompanying table was drawn up to show more in detail the differences between the results of the treatments he used. The figures given in this table show the differences between the treated and untreated steel of each heat; the plus sign means that the treated steel was better than the untreated by the stated amount for that given property, and the minus sign means that the treated steel was worse than the untreated by the stated amount.

Differences Between Plain Steel and Steel Treated with Ferro-Carbon-Titanium

Heat No.	Pounds of alloy used per ton	Yield point	Tensile strength	Elongation in 2 inches	Reduction of area
450	7.5	+6000	0	— 4.0	— 8.3
150	7.5	+1950	+5250	—13.0	—23.0
200	7.5	—2750	+2500	— 0.5	— 5.0
Average		+1730	+2580	— 5.8	—12.1
9	2.0	+1250	+ 750	— 1.0	— 1.5
1	2.0	+4500	+2900	— 2.0	—10.6
Average		+2870	+1820	— 1.5	— 6.0

The plus sign means that the treated steel was better than the untreated steel by the stated amount for that given property and the minus sign vice versa.

The table shows that Mr. Young's steel treated with ferro-carbon-titanium was consistently stronger and stiffer than the untreated, though less ductile. It has been the general experience of steel foundries using ferro-carbon-titanium that properly treated steel is stronger and stiffer than untreated, but a little less ductile on account of the extra carbon added with the alloy. This can easily be allowed for, if necessary, by dropping the carbon a little in the steel.

In one of our largest comparative tests on cast steel covering forty heats, the elongation of the treated steel averaged higher than that of the untreated by 1.5 per cent. The addition in this case was 3 pounds per ton. I believe Mr. Young's addition of 7.5 pounds per ton was larger than necessary. His 2-pounds-per-ton addition gave him in two heats a 7-per cent increase in yield point and a 2.5-per cent increase in strength, with only a slight decrease in elongation. The properties were therefore not, on the whole, inferior to those of the plain steel, and he apparently did not try the regular recommended addition, which is 3 to 5 pounds per ton.

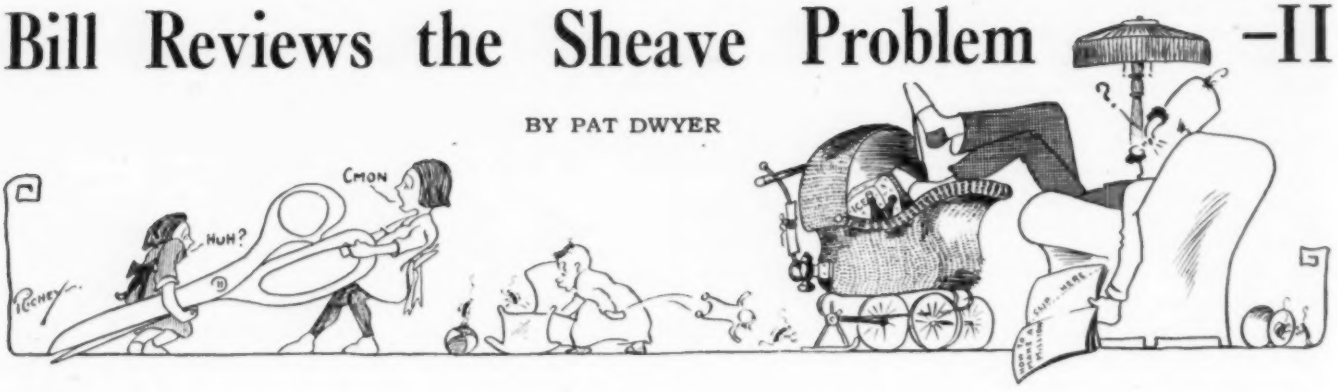
Canadian Firm About to Make Expansion

Established in 1878 by William H. Frost and Charles Jones, the Smith's Falls Malleable Castings Co., Ltd., Smith's Falls, Ont., recently was reincorporated as the Smith's Falls Malleable Castings, Ltd., with an authorized capital stock of $750,000.

It is contemplating doubling the capacity of its No. 2 plant, and provision has been made in its charter for the manufacture of steel castings. It will install an up-to-date machine shop. Officers of the company are: President and general manager, George B. Frost; vice president and treasurer, Dr. C. A. Patterson; secretary and sales manager, J. E. Frost. The company is the second oldest among the manufacturers of malleable castings in Canada.

Bill Reviews the Sheave Problem -II

BY PAT DWYER



LAZINESS is a dreadful affliction. I was reminded of this for perhaps the 500th time one night last week when I read in my favorite periodical a notice to the effect that if I wished to increase my earnings anywhere from 10 to $800 a week all I had to do was to sign, tear off and mail the attached coupon. If I had had enough energy to fill out, tear off and mail that coupon the first time I saw it many years ago and basing my increased earnings on the minimum amount set out therein, viz: to wit; $10 a week, I might now be rolling in wealth instead of creeping along one hop ahead of the sheriff and two hops ahead of the devil and the old clothes man.

I often have thought that if I were allowed to start all over again, what a wise lad I would be.

I resolved there and then to put the matter off no longer and decided to clip the coupon and mail it that very night, but what's the use of making resolutions! When I looked around for someone to bring me the scissors I found two young ladies engaged in an animated and acrimonious discussion touching on the point of where, when and how a king wears his crown. The first young lady held firmly to the opinion that a king wears his crown at all times with the possible exception of the time he spends in bed or in the bath-tub. Even on these occasions, she claimed that probably at night he places the crown on one of the posts at the head of the bed and drapes the remainder of the royal garments over the foot. She was willing to bet a million dollars if necessary to prove that there were hooks provided in the bathroom doors of all well regulated palaces and the king hangs his crown on one of them while performing his ablutions.

The second little maiden tilted her already tip-tilted nose a little higher in the air and said "You poor fish!" (Is it not regrettable the manner in which little sisters sometimes address each other?) The king only wears his crown for a few minutes on the day of his coronation after which it is packed away with the remainder of the crown jewels and only brought out on special occasions when he may wear it for a few minutes. I have seen kings in the movies hundreds of times and I never have seen one wearing a crown."

With the flattering, but sometimes embarrassing faith of children,—you know Paw knows everything,—they both appealed to me to settle the argument. Before the incident was closed I had forgotten all about the coupon and another potential $10 a week had gone to join the mythical host of those gone before. I don't know whether my explanation helped to clear up the question or not, for I never have seen a real, live king in person, or on the hoof, as they say in Chicago. My stock of knowledge on the subject of kings, and so forth, has been acquired at second hand and probably is unreliable.

A short time afterward Bill dropped in and I asked him what he knew about kings and their habits in the wild or natural state.

"What kind of kings," said Bill, "Poker, Biblical, or European?"

On being told that the point at issue was whether a king wore his crown steadily or only intermittently he said:

"Well, I'll tell you. To answer that question properly it is essential that I should know what you mean by the word *crown*. Some kings are crowned in the proper sense in which the word usually is employed; while others, well you are a man skilled in the use of words, accustomed to daintily picking and choosing the proper word to express the most delicate shade of meaning and therefore, you are aware that many words when used in the vernacular of the street mean something altogether different than they do when used according to Hoyle.

I felt constrained to point out to Bill that while our language perhaps was not all that it might be, still I never before heard any person lay the blame on our mutual friend Mr. Hoyle.

"Assuming that Mr. Webster allowed no errors to creep in when he was writing his well known best seller, we find the words *to crown* listed as a verb, transitive, and meaning an act or ceremony designed to confer honor on the recipient. However, when we go out among the highways and hedges, we find the word used as a synonym for many things of which in all probability the late Mr. Webster never even dreamed. When you hear an indignant citizen loudly, emphatically and sometimes, I regret to say, profanely declaring that he in-

A CROWN IS A CROWN EVEN AT THE PRESENT RATE OF EXCHANGE

tends to *crown* another, you are not misled for an instant into thinking that he intends to confer an honor on the party of the second part. Similarly when an enthusiastic body of rooters engaged in watching an exhibition of the great national game rises up on its collective hind legs and expresses an earnest desire to *crown* the umpire, no person, least of all the umpire, is deceived into thinking that any honor is intended or that the ceremony will be carried out and exemplified as coronations are performed in those countries which have a monarchial form of government.

"Not that it has any bearing on the subject, but merely as a point of possible academic interest, I often have wondered whether Rider Haggard had any satirical motive in mind when in that weird romance *She* he described the methods in vogue among the *Amahaggar* for putting their captives to death. You remember, as Haggard tells it, these birds were lineal descendants of the Yahoos, a race of people described with such a wealth of detail in Swift's *Gulliver's Travels*. The Yahoos had their own little peculiarities, but it remained for their descendants the Amahhaggar to think up the scheme of inverting a red hot clay pot, corresponding closely I imagine to a No. 75 crucible, over the head of the victim. The rite was known as *hot potting* and as a means to an end it left nothing to be desired."

"I know one person who would have drawn a hot pot if he had lived among these people and if garrulity had been an indictable offence." I said, "I asked you a plain, civil little question and you rambled away like an amateur foundry instructor explaining how to clay wash a gagger."

"The point is well taken by the honorable gentleman from Skowhegan" said Bill with a grin. "If you had not asked such a silly, blinkin' question in the first place I might now be half way through explaining the six remaining methods of molding a sheave wheel which I promised to show you the last time I was here."

"Taking them up *seriatim*, a word I believe taken from the Latin tongue and greatly favored by chairmen of committees and delegates to conventions, we first consider the method shown in

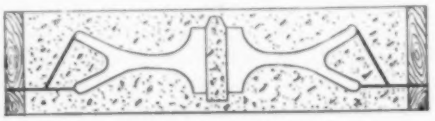


FIG. 1—ALL IN THE COPE

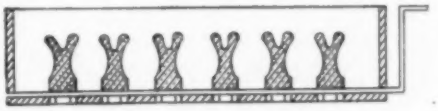


FIG. 2—PATTERNS MOLDED ON EDGE

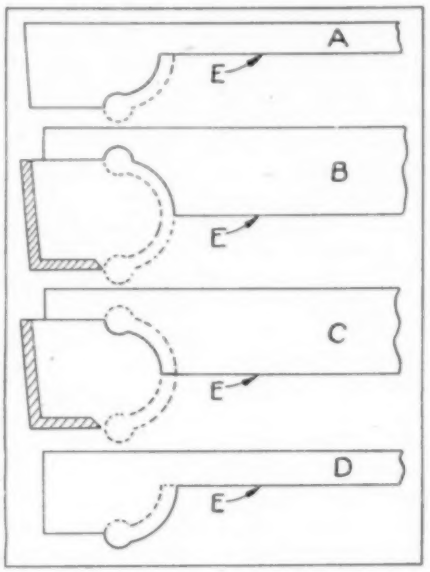
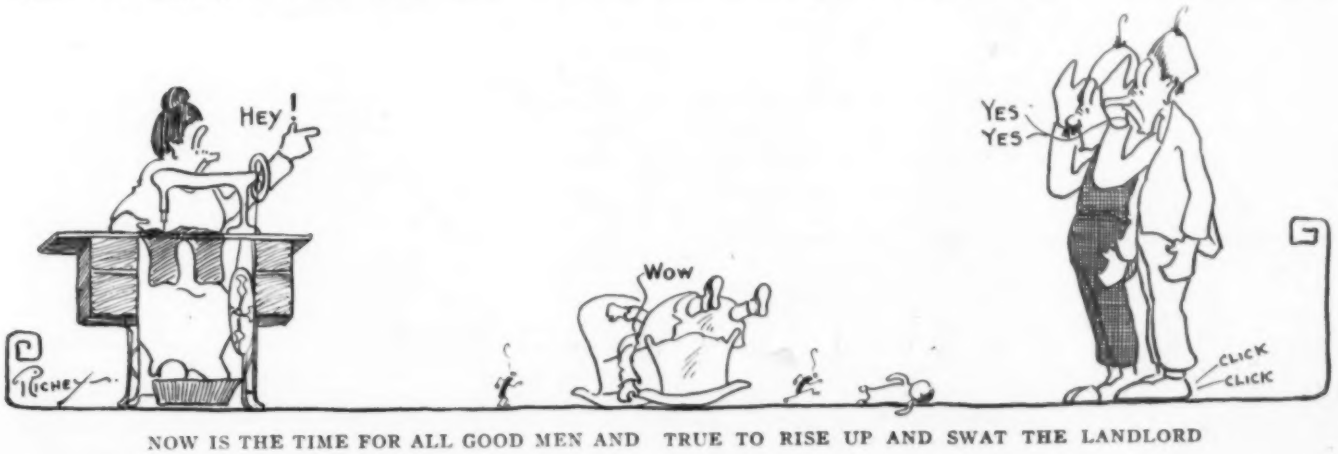


FIG. 3—FOUR SWEEPS EMPLOYED IN FORMING THE MOLD FOR A SHEAVE RING

Fig. 1. This really is more a trick of the trade than a commercial method for making a sheave wheel. While not so elaborate, it is in the same class as the cup-saucer-and-spoon casting made in their spare time by ambitious young molders of the old school as an evidence of their skill and ingenuity. The peculiar feature of the method shown in Fig. 1 is that only one section of a flask is required to make the mold. The method is only applicable to small sheaves, say up to 6 inches in diameter. The lower half of the pattern is bedded in the floor or in a long narrow drag, if it is desired to make several castings. If the latter plan is adopted, the drag is filled with sand, tramped off and the joint scraped off flush. A handful of sand is laid on the prepared bed and the pattern rubbed down to a bearing. A parting is made all around the lower edge and extending out an inch or two horizontally. The top half of the pattern then is set on and riddled sand packed into the groove. A slanting parting is made from the top edge of the pattern to the horizontal parting. A suitable iron bushing or small round flask then is set on and rammed full of sand. This ring is lifted off and set down on its side after which the top half of the pattern is withdrawn. Paste then is smeared on the slanting parting, the cope is returned and pressed down hard. A light, long wood screw is inserted through the runner opening in the cope and screwed into the lower half of the pattern. A light rod resting on the top of the cope and passing through the eye of the wood screw serves to bring the lower half of the pattern and the sand ring forming the groove up with the cope when the latter is lifted off the second time. The cope is turned on its back and the ring of sand forming the groove pressed down around the edge lightly with the fingers. The screw then is removed and the lower half of the pattern withdrawn after which the cope, to which the ring by this time is firmly attached, is returned to place and when weighted down is ready for the metal.

"The method shown in Fig. 2 is the best I ever have seen for making a small, plain sheave, that is a sheave having a plain web without any openings through it. The rigging of course



NOW IS THE TIME FOR ALL GOOD MEN AND TRUE TO RISE UP AND SWAT THE LANDLORD

is too expensive where only a few castings are required, but where small sheaves are made in large quantities there is no other method I know that can touch it for speed, accuracy and the production of perfect castings. It is a radical departure from the usual methods in that the patterns are mounted vertically and the molds are made in a flask like those from any ordinary split pattern.

"The required number of *half* patterns, attached to a rod terminating in a crank handle, are mounted on a cast iron stripping plate. Either a long narrow snap flask or a number of small iron flasks accurately planed and fitted can be employed for making the molds. It is essential of course that the patterns be arranged on a center line and also spaced longitudinally in such a way that both halves of the mold will coincide. In practice one half of the flask is set on the plate, filled with sand and rammed. The crank handle is given a turn through 180 degrees, a suitable stop on the frame of the machine indicating when that point has been reached. The action of the crank imparts a circular motion to the half patterns which strips them through the plate leaving the half mold ready to be lifted off and set on the floor. The action of the crank then is reversed throwing the half patterns up through the plate into their original position, where the operation is repeated. The impression left in the joint of the mold by the long rod serves as a core print for the hub cores.

"A set of sweeps employed for sweeping a large sheave ring in green sand is shown in Fig. 3. This method usually is adopted when only one casting is required and the cost of a complete pattern would be excessive. It is particularly adapted to the molding of large sheaves in which steel rods are used for arms. The different sweeps are employed in the order indicated, reading down.

Sweeping a Mold

"A hole is dug in the foundry floor and a spindle set up in the usual manner. Sand is piled across the bottom of the hole and butted off approximately to the desired shape. The sweep *A* then is adjusted at the proper height and a part of the mold swept conforming to the shape of the inside of the lower half of the groove. The dotted line on *A* indicates the thickness of sand removed later to form the mold cavity. Sweep *A* then is removed and a lifting ring, designed to carry the green sand ring core, lowered into place. Facing sand is riddled on, followed by a row of rods set close together, after which sand is shoveled in and rammed lightly up to the top of the ring and extending a distance on the inside corresponding to the thickness of a pattern, had there been one. Sweep *B* then is set by resting the line *E* on the bed formed by a corresponding line on sweep *A*.

Other Methods

"Sweep *B* imparts to the sand the shape of the extreme upper surface of the casting. In other words when sweep *B* is removed the mold is in the same relative condition on which to ram a cope as if a pattern had been employed. The cope flask then is set on, rammed full of sand, lifted off, rolled over and finished. Sweep *C* is adjusted next and serves to remove the thickness of sand indicated by the dotted line. The crane is attached to the lifting ring by suitable chains and turnbuckles. A tension is placed on the latter to insure an even strain all around and then the ring is lifted out and set on stands where it is finished and blacked. The last sweep to be employed is the one marked *D*. It is adjusted in the same manner as those preceding and is used to remove the thickness of sand indicated by the dotted line. After the different parts of the mold have been finished and the hub cores and steel arms set, the mold is reassembled and poured.

"The eighth and ninth methods for making a sheave are not illustrated. The first two are emergency methods and the last is almost entirely a dry sand proposition. The eighth method has been employed successfully to make a green sand mold off a broken casting. The casting was clamped together, wedged up in a pit and treated as a pattern. Two half circle plates were bedded around the outside flush with the lower rim. The mold was rammed as usual and after the cope had been lifted off, the plates carrying the ring core were backed away from the casting, lifted out and finished. After the broken casting had been lifted out the different parts of the mold were reassembled.

"The ninth method was employed to solve a similar problem in a different manner. The broken casting was set up on a core plate and a sufficient quantity of core sand rammed around it to fill the groove and to extend on the outside to correspond to the usual core print. The ring core was cut through with a trowel at six equidistant points, after which the casting and core were run into the oven and dried. On the following day the combination was taken out of the oven and without removing the cores was treated as a pattern and a mold made from it. After the cope had been lifted off, the casting and core were lifted out and set on a board. Upon rapping the casting, the core sections easily were removed and returned to their proper places in the mold.

"The tenth and last method is applicable to large sheave rings, that is rings with neither hubs nor arms but provided with lugs by which they are bolted on to built-up centers. A solid pattern provided with two ring core prints, one on the inside and one on the outside is employed. The pattern is bedded in the floor and when it is withdrawn, it leaves the impression of the lower side of the casting. Segment dry-sand cores are set in the outside print to form the groove and then other segment cores which rest in the print on the inside and on the upper surface of the groove cores on the outside, are employed to act as a cope. It is an easy, simple and fast method for making large sheave rings of the character indicated."

"As I remarked in the beginning," said Bill, preparing to go, "I am not an old man and do not pretend to have seen everything. It is quite probable there are additional methods for molding sheave wheels of which I am not aware. If I come across any new ones in the course of my travels I shall let you know."

The lady who dispenses the high justice, the middle and the low and who I thought never had harbored vindicative thoughts in her gentle bosom looked up from her sewing long enough at this point to remark: "I am not interested in your silly old sheave wheels or whether you find one away or 50 by which to make them, but if you can show me one good reliable, workable method for slipping the skids under some of the pirate landlords in this town I shall do all that one person reasonably can to have your statue erected in the hall of fame."

New Company Buys Plant

The Myerstown Foundry & Mfg. Co., Myerstown, Pa., has purchased from the Treadwell Engineering Co., the plant which the former has been operating for a number of years. The Myerstown company during the past year completely electrified the entire plant and contemplates making a number of additional improvements in the near future. The plant includes a fully equipped gray iron foundry and pattern, forge and machine shops and the company expects to add numerous new tools shortly. The officials of the company are: President, L. F. Krum; vice president, E. R. Euston; secretary, S. P. Line.

The Schwinn Foundry & Machine Co., Dubuque, Ia., recently has changed its name to the Dubuque Foundry Corp. William V. Toepel is secretary.

Job Shop Adopts Specialty Methods

Methods and Systems Involving Standard and Elaborate Rigging Which Are an Economic Factor in Mass Production Often May Be Modified in the Jobbing Foundry

BY R. R. CLARKE

DIFFERENCES between conducting a foundry devoted to manufacturing a standard line of castings on quantity production basis and operating an ordinary jobbing shop are so pronounced as to admit of no comparison. In the one instance methods, mixtures and rigging are standardized and it is comparatively simple to train ordinary labor to carry out the daily routine. Supplies and materials can be bought in large quantities because their immediate use is assured. Operations can be carried on irrespective of the line of orders on the books, for the finished product can be carried in stock where it is available when the orders are in excess of the daily or monthly capacity of the plant. In a jobbing shop new problems arise every day. Rarely is an order received which will pay for the initial expense of fitting up elaborate rigging. New patterns have to be made constantly, and frequently have to be tried out in the foundry with no exact precedent for a guide. Materials and supplies cannot be bought in large quantities and stored because there is no definite assurance just how much of each will be required in a given time.

In a job shop we once received an order for one aluminum crank case which required over an hour to mold. We have to take the corebox and pattern as they came from the customer, work the pattern in an ill-fitting flask designed for general work and melt the aluminum in a ladle under a preheater. At some distant time the customer may want another; but there was no guarantee that we would get the order. Another instance is appropos. We received an order for nine small gear wheels 3 inches diameter, 1½ inches face and containing 23 teeth cast on. The pattern had been turned, teeth sawed out on a band saw, roughly finished and given one coat of shellac. We positively couldn't make the job in green sand, so we sawed out an outside frame, made the mold as a core, dried it, patched it and rammed it in a green sand mold using a flat back for the cope. On quantity basis we should have had a perfect metal pattern made, and perhaps gone so far as to mount it with a neat fitting stripping plate for machine molding in green sand.

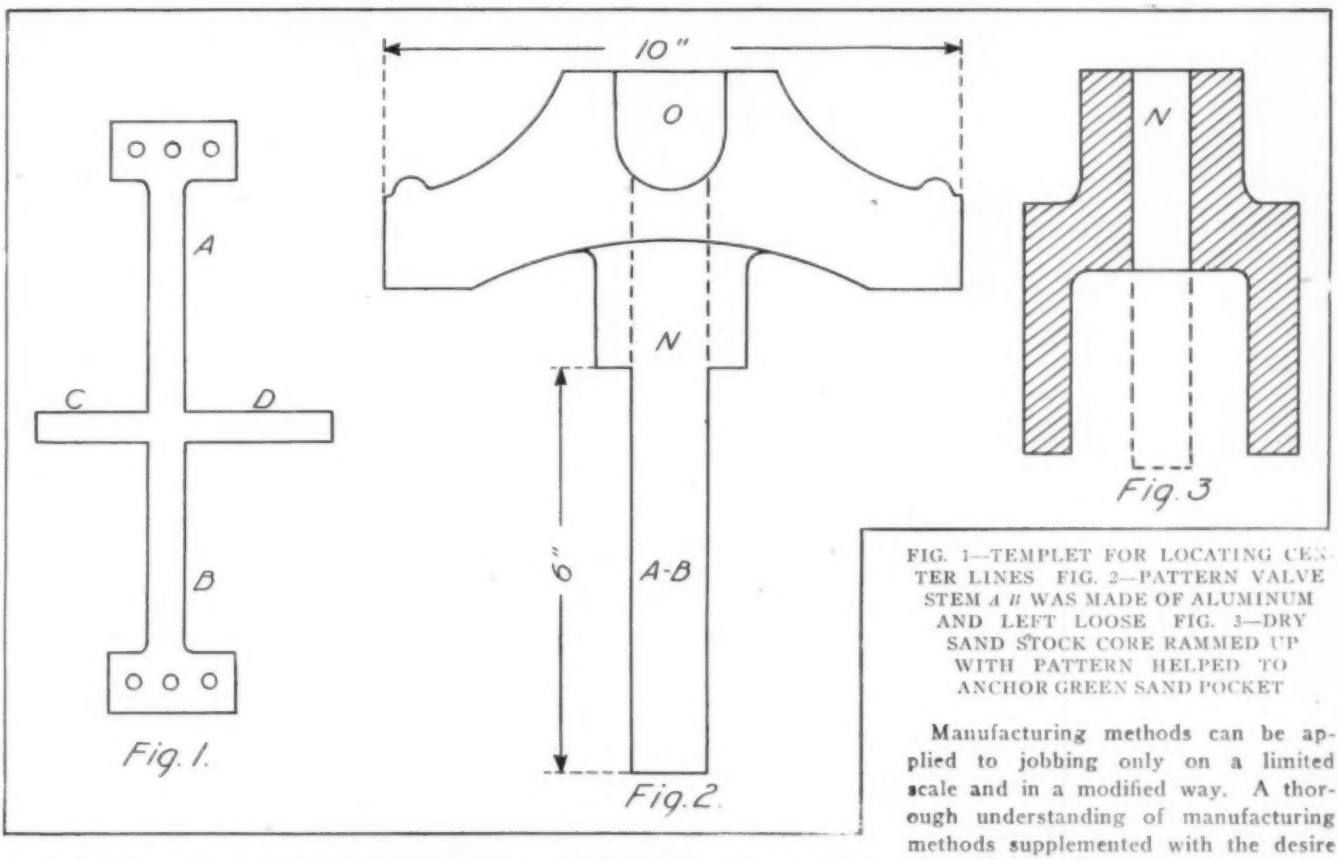


FIG. 1—TEMPLET FOR LOCATING CENTER LINES FIG. 2—PATTERN VALVE STEM *A B* WAS MADE OF ALUMINUM AND LEFT LOOSE FIG. 3—DRY SAND STOCK CORE RAMMED UP WITH PATTERN HELPED TO ANCHOR GREEN SAND POCKET

Manufacturing methods can be applied to jobbing only on a limited scale and in a modified way. A thorough understanding of manufacturing methods supplemented with the desire and ability to use them as a basis of operation is a paying combination. For illustration: A jobbing shop receives an order for 50 hexagon bushings 4 inches in diameter, 12 inches long, 3 inches core; one split pattern furnished. If these were to be manufactured in large quantities we would make four metal half patterns and mount them on both sides of a steel plate to secure two complete castings from a mold. Making two extra half patterns even from wood would reduce the profit considerably on fifty castings. We locked the two half patterns furnished on a board equidistant

from the center lines of the flask and made both copes and drags in interchangeable flasks from this one side of the board at practically no expense, since we had several of these boards in reserve with the center lines clearly and accurately defined. This method would not be economical on large quantities because the long and constant service of the plate on interchangeable flasks would develop a shift, something less liable to occur by the two-side method.

A few snap flasks of different sizes often will be found useful in a jobbing shop. However, for the general run of jobbing work the interchangeable flask of solid iron or steel is more suitable. Pressed steel flasks are ideal for the purpose. In selecting them two or three sizes should be considered and the flask pins should be at least 3 or 4 inches long since it is the length of the pin that determines the depth of pattern that can be used in them. The different sizes and number of flasks of each size will vary with shop conditions. In our shop we have 96 flasks, 12 x 16 x 4 inches, cope and drag; 12 flasks, 16 x 18 x 5 inches, cope and drag; and 24 flasks, 20 x 22 x 4 inches, cope and drag. We find that this assortment covers the field admirably. These steel flasks, interchangeable type, need not be confined to molding plate mounted work but answer equally well for bench and floor work of any type.

Compressed air is a foundry necessity. Considering its many and varied uses the wonder is that any foundry of any consequence should be without it. A great many mounted patterns can be lifted without vibrators. A great many others can not. This is especially true in a jobbing shop where furnished patterns must often be used. They represent all grades of pattern-making, good, bad and indifferent. Taking them as they come and molding them by board methods requires a strong vibrator attached to the board in the majority of cases. Both the electric vibrator and the pneumatic are efficient when working right; but neither always work right. The pneumatic is smaller and less cumbersome than the electric but this feature is sometimes offset by the latter's ease of application.

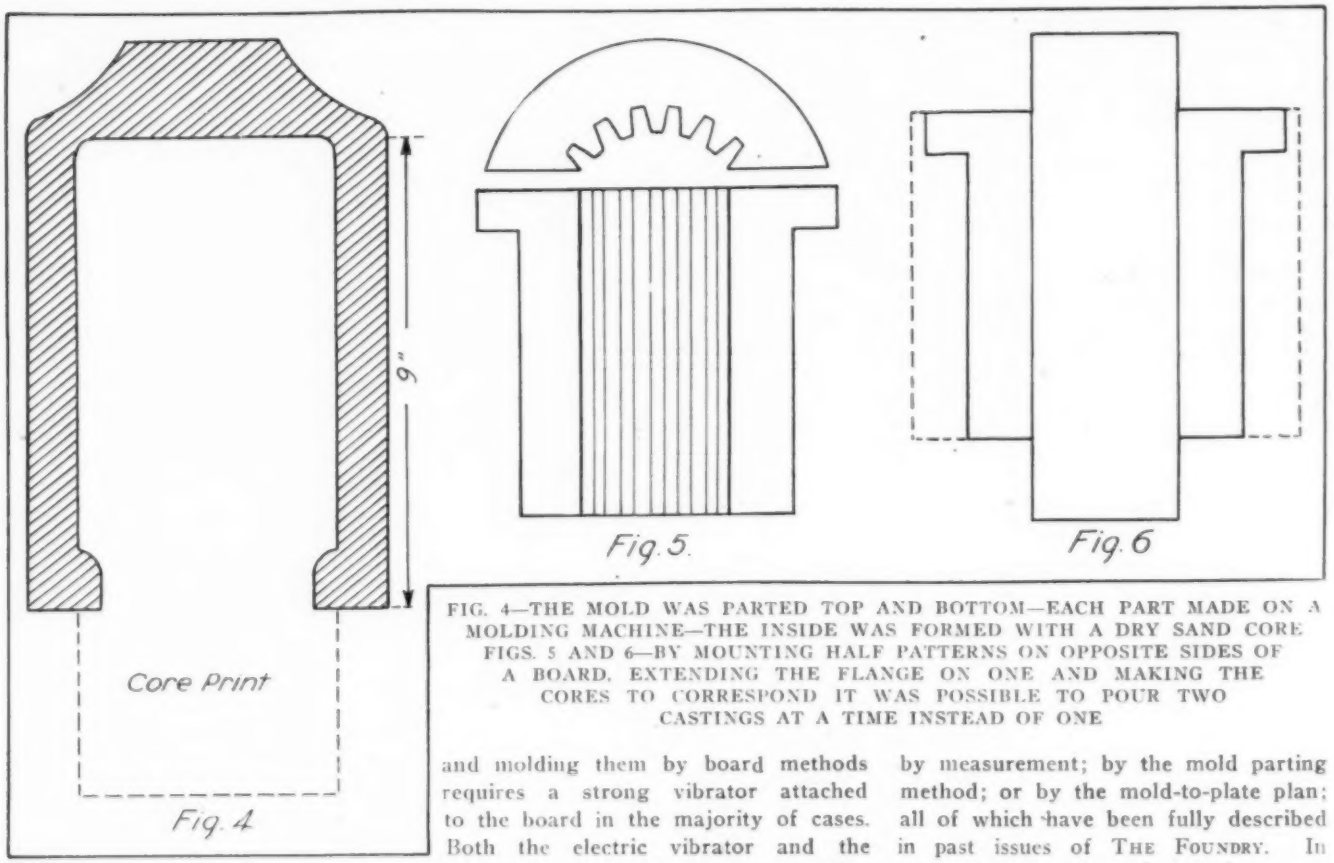


FIG. 4—THE MOLD WAS PARTED TOP AND BOTTOM—EACH PART MADE ON A MOLDING MACHINE—THE INSIDE WAS FORMED WITH A DRY SAND CORE FIGS. 5 AND 6—BY MOUNTING HALF PATTERNS ON OPPOSITE SIDES OF A BOARD, EXTENDING THE FLANGE ON ONE AND MAKING THE CORES TO CORRESPOND IT WAS POSSIBLE TO POUR TWO CASTINGS AT A TIME INSTEAD OF ONE

Preparing Pattern Boards

Metal patterns intended for long and constant service generally are mounted on steel plates. These are not as suitable for the job shop as wood boards on which patterns can be mounted and dismounted quickly. The boards should be made of hard lumber thoroughly seasoned, and should be at least 1-inch thick. To harden and protect them against moisture they should be soaked in oil a couple of weeks before using. It is advisable to strengthen and protect them with an iron band or strip around the outside. Inset metal plates should be used for the flask pin holes. In mounting patterns, we either place the pattern parts or halves on one side of the board or on both sides. The first named method already has been mentioned. A means for quickly and accurately locating the center lines of the board requires a templet containing holes corresponding to the pin holes in the flask as shown in Fig. 2.

Mounting patterns on both sides of the board or plate can be done by measurement; by the mold parting method; or by the mold-to-plate plan; all of which have been fully described in past issues of THE FOUNDRY. In every instance the principle is to get the pattern parts absolutely in line with each other on opposite sides of the plate. For accuracy, the two-side method having cope and drag rammed up together is best, since the possibilities of a shift are greatly reduced.

To withstand the pressure exerted on pattern boards used on squeezing machines, our practice is to use frames with supporting strips so located as to clear the mounted patterns. A more cumbersome method is to use a hard rammed cope impression as a sort of follow board in squeezing the drag.

Many customers are quite willing to let the foundry make both patterns and castings. When a foundry makes its own patterns, it can make them to suit its own particular conditions.

It often pays to discard the pattern furnished and replace it at the foundry's expense; or make a few additional patterns to mount on a board. Some time ago, we received an order for 300 valve stems, three solid patterns furnished. We laid these patterns aside; made five split patterns, mounted them on a board and machine molded them, saving many times the price of the patterns and getting the job out in one-third of the time which would be required if we had used the original patterns.

We received a solid pattern for a bushing 8 inches long, 5 inches inside, 6 inches outside. The pattern had core prints top and bottom for vertical molding with a dry sand core. Two hundred castings were wanted. Aluminum patterns were made to leave their own green sand cores. A 2-inch high wooden upset was rammed and used for a drag. The patterns were set on the drag frame and rammed in two 4-inch drags of steel flask, when a level parting was made. Copes were squeezed on a molding machine and set over the cheeks for pouring. The patterns cost $15.00, not including aluminum material which afterward was returned to metal stock. The saving in molding time was about 25 per cent. The castings were cleaner and smoother, and the entire cost of dry sand cores was eliminated. The saving in metal fins and cleaning time was considerable.

Further Instances

We received an order for 300 small blank gear wheels accompanied by two unsuitable patterns and core box. We turned up two new patterns to fill a 12 x 16 inch flask; made a gang core box; mounted the patterns and machine molded them; at a cost for patterns and core box of about $8.00. The saving in molding time and expense was approximately 60 per cent. During shipyard activity we received orders for many propeller nuts of different sizes; a very limited number of patterns being furnished in each case. In most cases we had additional patterns made and mounted for machine molding at a remarkable saving.

Molding Machines Can be Adapted

The idea is prevalent in some quarters that molding machines will not pay on jobbing work. It is true they cannot be worked to the same advantage as in manufacturing, yet on straight job work we have been operating machines for over two years and have realized substantially on them. The main thing to do is to create every possible opportunity to use them. In other words, if they don't apply, make them apply. Suppose you have ten flasks of 12-inch pin brasses to mold vertically and have a jar-squeezer machine. Squeeze up a drag on a 2-inch frame on a perfectly level follow board and set it on the floor. Take three parts of a 4-inch flask and set them on a level follow board arranging the pin patterns to the best advantage and with the draft end down. Fill the flask with sand and jolt hard, supplementing the jolting with a little hand ramming when necessary. Make a level cope parting, dust some parting compound on the drag, set the cheek on the drag, ram a cope on the cheek; draw the patterns and you have made the machine do three-fourths of the work with a corresponding saving in time and expense. The idea that only plate work can be made on a molding machine is entirely erroneous. In plate work all the machine does in a great many cases is to ram the mold by jolting, by squeezing or by a combination of the two methods. Pattern plate lifting is attended to by hand and is quite independent of the machine. Loose patterns can be jolted and squeezed as well as plated patterns if proper methods are used; therefore, the advantage of the machine is approximately the same in both cases. Of course, the separate cope and drag plate, the stripping plate and the pattern lifting device defy comparison but these are missing items in many manufacturing plants and quite out of place in a general jobbing shop. Among foundrymen the idea is by no means uncommon that a great many patterns cannot be handled on the molding machine. Personally, we are of the opinion that whatever human skill can do by hand can be done by mechanical means.

When a great variety of incoming patterns can be made on plain hand squeezers, the possibilities of the machine are more appreciable. If you cannot make a complete mold on a machine make as much as possible and gain that much. If you feel you must pean ram by hand, surely you can squeeze instead of butt ram, and thus save the time and energy of the rammer, the strike off and the levelling of the sand bed for the bottom board. By this single advantage you can sometimes gain from six to ten molds a day. If you can make up a number of flasks having the patterns all in the drag and only requiring a flat back cope, even though you feel you cannot utilize your machine on the drags you can easily reduce your molding cost by squeezing copes to cover them.

Specialty Man An Asset

In working machines the average molder and even the old-time overseer will, to say the least, do little to bring out their advantages. It is therefore primarily essential that you have a brainy progressive man on the job capable of planning these features and putting them through. If you have not such a man in your shop your first move should be toward getting him. By actual comparison it was found that a molding machine would take loose patterns around a set gate and make a mold from patterns drawn singly by hand in nearly the same time as a molder would take the same patterns plate mounted, ram the mold by hand and draw the patterns collectively by plates. It is therefore apparent that if you do not

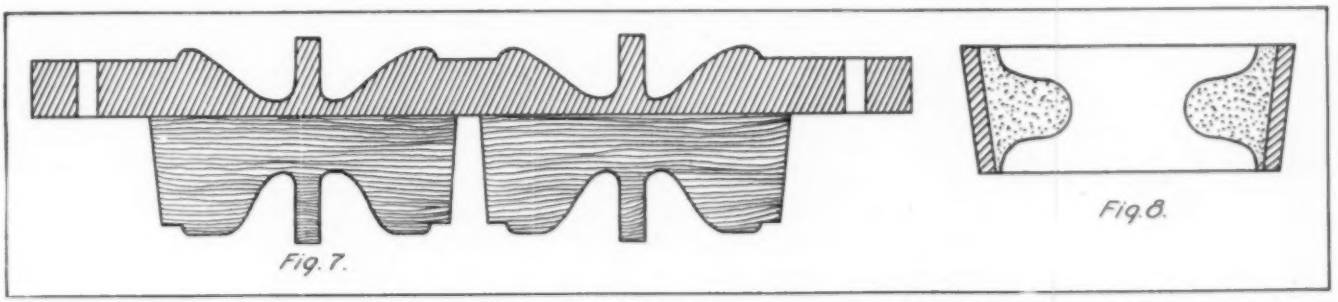


FIG. 7—SECTION OF METAL PATTERN PLATE CARRYING COPE IMPRESSIONS OF TROLLEY WHEELS—WOODEN DISKS ARE FASTENED TO THE BOTTOM SIDE FIG. 8—SECTION OF METAL TRAY USED FOR MAKING THE GROOVE CORE FOR THE WHEEL

have molding machines and do not care to get them; you at least can realize half their advantages in jobbing by resorting to plate mounting schemes wherever possible and working these plates altogether by hand. In mounting plates for jobbing and in working machines the main things to be remembered are that the methods adopted must be quick, comparatively inexpensive and practical.

Interesting Examples

Proper selection of a machine for jobbing is important. We have known cases of job shops buying machines, trying them and relegating them to a corner of the shop as impractical. Making due allowance for other natural causes the significant fact remains that selection has often been primarily at fault. Being an all-around concern the job shop wants an all-around machine and that, to our mind, is the simple pneumatic jar squeezer combined. Hand-jolt and squeeze and hand-squeeze machines are undoubtedly efficient; but pneumatic machines of the same type are more so.

We shall now refer to a few of the many instances in our jobbing experience where manufacturing methods were adapted.

A number of patterns were furnished for brazing flanges, all sizes, with draft from back side down, throwing the face side in the drag, which was correct. We tacked the patterns on a board with a set-gate, and molded them complete on a hand squeezer by making flat back for drag and carrying entire mold in the cope. Scarcity of flasks frequently held up machine molders so we squeezed up 2-inch frames to serve for drags and doubled the number of molds from a given number of complete flasks at hand.

Two hundred armature bushings were ordered from patterns furnished late on Saturday. The castings were wanted on the following Wednesday. By mold to plate method we mounted patterns on two separate boards. Cores delayed work due to time consumed in drying 3¼ x 12 inch core from solid box. Two coremakers made 200 half cores from halves of solid core box furnished; afterward blocking them with green sand, top halves gaining time and saving fuel and core material.

Half bearing liners with one flanged end and green sand core were ordered in lots of from 100 to 250. The iron pattern furnished was heavy and mean to lift by hand. We made a neat mold complete from patterns, filling in the flange end of the mold to assume the same contour as the remainder; separated the cope from the drag by ½-inch strips and poured the mold full of aluminum; thus securing an aluminum plate with a depression corresponding exactly to the journal depression in the pattern and terminating in neat end partings as made in the mold. We took this aluminum plate and drilled holes to accommodate standard 12 x 16-inch flask pins; then sawed out a wood block roughly corresponding in size to the journal depression in the plate but ⅜ inch smaller diameter. The depression was afterward partly filled with liquid plaster of paris, the block of wood set in this liquid plaster and the depression filled level full with additional plaster. After the plaster had set the pattern mounting board was placed over the aluminum plate with pin holes of both coinciding. While in this position screws were inserted through the pattern board into the wood block embedded in the plaster. When separated the board contained a perfect male match of the female impression. We set this original iron pattern over the male form, anchoring it with screws into the wood block beneath. In machine molding, the drags were made on the aluminum plate, rolled over and the plate lifted off; copes were made separately on the pattern board.

Three hundred small journal bearings were wanted from six patterns furnished. We made two half round core prints of wood 12 inches long the same diameter as the journal bearing. Three bearings were tacked on one core print, 1½ inches apart and three on the other; and then attached to a pattern board and gated. The cores were made from a half round stock core box and the molds made on machines. The copes were perfectly flat.

Further Examples

Flanged valve bodies developed a shift from ramming cope and drag separately on a hand squeezer machine. These half patterns were on opposite sides of the same board but rammed up separately due to the impossibility of hand lifting cope flask from off the pattern. To remedy this condition the cope half pattern was placed on the same board with metal dowell pins. We afterward had no difficulty in ramming a cope and drag together and lifting the cope pattern by hand.

Machine molding the valve disks Fig. 2 was handicapped by a 7-inch lift in the drag to clear the stem *AB*. We made *AB* of aluminum and long enough to reach to *O;* dished out the pattern board to correspond with the under surface of the pattern; mounted the top half of the pattern on the cope side of the board; placing the bars marked in the drag side of the board; then drilled a hole through *N;* on through the board and pattern to *O;* the hole being large enough to allow the stem *AB* to pass through. We used a wood block in *O* in ramming the drag; then rammed the cope and lifted the flask off. The stem *AB* was pulled through the hole and out at *O;* the pattern acting as a stripping plate. The board was then lifted and the mold closed.

Castings in Cope and Drag

Five hundred disks with center bars were ordered from eight patterns furnished. We tacked four patterns in a row lengthwise along outer edge of flask and four patterns in a row on a longitudinal center line, with a gate between the two rows. We then squeezed 42 drags and set them on floor, removed the center row of patterns and the gate and squeezed 42 copes with only the edge row of patterns on the board. The copes were put on and the molds poured resulting in 12 castings in each mold from the eight patterns furnished.

Fig. 3 shows a cope nut pattern from which a considerable number of castings were ordered. Mounted pattern part is shown below dotted line on drag. The height of the hexagon top was increased by thickness of the board and mounted in the cope. The hole *N* was drilled within the thickness of the board to the top of the hexagon bars. In ramming the drag a dry sand core was used in *N;* the core extending deep into the green sand pocket as shown in the dotted line. The chief advantages were absolute security and correct position of the dry sand core, and the stability it furnished to the green sand pocket surrounding it.

An order was received for 100 large reels used in fishing boats. The core prints on the pattern were two inches too long to enter the 12 x 16 flask. We obtained permission to shorten the core prints to 11¾ inches and altered the core box accordingly. The pattern was mounted on a board and machine molded, saving at least 40 per cent in time.

Three hundred castings wanted as per Fig. 4, core to be strictly central; no patterns furnished. Our pattern was parted top and bottom. The middle part of pattern was mounted loose on

one side of the board, the core print on the other. The top piece was mounted on a separate board; all mounting being done by mold to plate method in absolutely true flasks. The drags were squeezed, the cheeks jolted and hand rammed using two parts of 4-inch flasks with 1-inch metal frame between. The top parting was made level and the pattern drawn by hand. The core was set in the drag print after which the cheek was closed over it and the core centered at the top end. Flat squeezed copes were used.

Special Cores Solution

In the half liner shown in Fig. 5 a pattern and half core box were furnished. We discarded this pattern and turned up a split pattern for a full bushing. To one-half pattern we added a ¼-inch thick liner as per dotted lines in Fig. 6. We mounted the half pattern with liner on one side of the board; the plain half pattern on the other side; altered the core box to make some cores with wings and some without to correspond. The drags were machine molded after which we set the cores with wings; afterward covering these winged cores with cores without wings. copes containing molds almost similar to drags were also machine molded and set on thus getting two castings per flask instead of one and saving the expense of making flat back copes to cover drag molds besides reducing gate metal required.

Several alternative methods often suggest themselves on one job. We have an order for 200 trolley wheels to be made with green sand groove cores. For this job four patterns with solid hubs were furnished. Prospects are good for repetition orders. We see three avenues of escape from the old slow, double roll over method. One is the dry sand groove core. Another is to make metal rings or trays two inches larger inside diameter than the wheel and of the same height. The wheels can be rammed up in these trays and the trays afterward rammed.

Trolley Wheels on Pattern Plate

The third idea is now being worked out. It is to ram up the four half patterns in a flask large enough to give a mold impression of the cope side of the pattern and allow for casting an aluminum plate. The drag half of the mold is a flat back. We cast this mold of aluminum and get a duplicate of the cope of the pattern on one side and a plane surface on the other. We then turn up four pieces of wood 2¼ inches larger in diameter than the patterns and mount these wooden pieces on the opposite side of the cope impression. Next we will cast the metal rings or trays already referred to; use one of the patterns furnished and make green sand groove cores in these trays taking necessary measures to mechanically insure absolute central position of the pattern. The molding will be done by machine and the trays carrying the green cores set the same as a dry core would be; the wooden pieces referred to being so turned on the bottom side as to correspond to the patterns. At slight cost we will thus reduce the proposition to straight machine molding and liquidate the expense with the present order, thus giving us our own patterns and a decided competitive advantage for future trade from a service standpoint. The scheme could be just as well worked out with dry cores but it must not be forgotten that a coremaker's time is as valuable as a molder's and that core compound, baking and blackening cores cost money. Mounting split patterns on a pan-shaped plate is another possibility of escaping the double roll-over but was deemed the less attractive in this case.

How and Why in Brass Founding

By Charles Vickers

Many Fluxes Used With Leaded Alloys

We would like to know what flux is used in leaded alloys to prevent separation of the lead and the copper when the alloys solidify in the mold. What percentage of flux must be used with the following alloys?

1—Copper, 60 per cent; lead, 40 per cent

2—Copper, 62 per cent; lead, 35 per cent; tin, 3 per cent

3—Copper, 65 per cent; lead, 30 per cent; tin, 5 per cent.

No flux whatever is required in the case of number 3 alloy, as 5 per cent of tin will *hold in* 30 per cent of lead, and this alloy is made in large quantities without any flux, just covering with a little charcoal.

Alloys number one and two, are often fluxed with sulphur, although if they can be made without flux, it is always best. Every maker of leaded alloys has a different flux, and the proverb of one man's meat being another man's poison, applies exactly to this matter of a flux to *hold in* lead. Some prefer to add 2 per cent of an alloy of 50 per cent copper, and 50 per cent nickel; others as before remarked use sulphur in some form, from roll sulphur to sulphates of the alkali metals.

If sulphur is preferred, use from 0.25 to 1 per cent, according to the success met with in holding the lead. The allusion to the proverb means that each one has to work out this problem for himself, because experience has taught that no formula can be given that can be used by others with success. We suggest you experiment with soda ash, plaster of Paris, sulphur, nickel, lead sulphide, and combinations of these substances.

Non-Arcing Brass Alloy

We would appreciate any information you may be able to give us in regard to the formula for a special non-arcing brass suitable for casting two 500-millimeter spheres for a 500,000 volt standard spark?

The following alloy will be suitable for the purpose outlined: Copper, 90 per cent; tin, 5 per cent; phosphor tin, 5 per cent. The phosphor tin should contain 5 per cent of phosphorus.

No Flux Needed When Melting Alumium

We are making our own matchplates of aluminum and in melting the metal we have considerable loss, which appears to us to be excessive. We have wondered how to cut this loss and as we melt in ordinary crucibles have thought of using charcoal on the metal as in the case of copper alloys. We would like to know if charcoal functions the same in the case of aluminum as with brass and bronze?

Charcoal does not function the same with aluminum as with brass and bronze.

Aluminum cannot economically be handled the same as brass and bronze. Its specific gravity is roughly one-third that of bronze. When molten, aluminum will stick to foreign substances and coat them with a thin film. Therefore, if charcoal is used in connection with aluminum, the loss would be increased instead of diminished, as the aluminum would adhere to the pieces of charcoal and be skimmed off the pot. Aluminum does not oxidize nor take up sulphur readily at casting temperatures. Therefore no reactions occur between these two elements and aluminum to fill the metal with gas. For this reason aluminum is usually melted without the use of a flux of any kind. When melting aluminum in crucibles or in a covered furnace of any sort, great care must be exercised to see that its temperature never rises to a point where the fluid gets brighter than a dull blood red. When strongly heated aluminum is one of the most powerful chemical agents we possess. When overheated in a crucible there may be great loss of metal due to the formation of oxides and nitrides, aided by the carbon of the crucible. Therefore, give great attention to the aluminum while it is melting; keep the temperature low, and just before pouring flux it with a small piece of chloride of zinc, which will separate the metal from the dross, allowing the latter to be skimmed off as dust.

Using Chills to Replace Special Cores

We are making aluminum cylindrical castings that have a hole through that is ½-inch in diameter and carries two keyways on opposite sides of the cores. We desire to know if it is possible to cast these by means of steel chills that can be driven out and will save the labor of machining that part of the casting. What must we use to coat these chills to make them come out easily?

One method that might be tried is to coat the chills with core oil, then dust them with fine, sharp core sand, and afterwards bake them in the core oven. The most satisfactory method would be to *die cast* these parts; this requires special knowledge of the art, and a proper machine for operating the dies. If the chills are left in the castings until the latter have cooled, the castings will crack. If ordinary brass casting methods must be employed, no doubt it will be more profitable to adhere to regular sand cores and machine the castings.

Attempting to extract a chill core by pounding it out with a hammer or by other such means is useless. It will have to be withdrawn before the metal shrinks and grips it, and can only be done by the methods used in die casting in which the cores are withdrawn by means of levers or some other mechanical power. Little time is given by the contracting metal. Therefore, the withdrawal has to be positive and certain unless cracked casting are to result.

Manganese Bronze Used for Boat Rudders

Kindly give us an analysis for manganese bronze to be used for making rudders for boats. These castings must be extremely rigid to withstand the strain.

The following analysis will be suitable for the purpose stated:

ALUMINUM BRONZE ANALYSIS

Copper	56.0 per cent
Zinc	41.5 per cent
Iron	1.2 per cent
Tin	0.7 per cent
Manganese	0.1 per cent
Aluminum	0.5 per cent

Should there be any doubt as to ability to make the above alloy, you might try the following formula, which will be found easier to make and will give the physical properties desired. Because of these two qualities economy is frequently found in using it in preference to the alloy that is more difficult to make, even though the cost of the metal in it is higher. The alloy follows:

HIGH TENSILE ALUMINUM BRONZE

Copper	44 pounds
30% Manganese copper	12 pounds
Zinc	42 pounds
Aluminum	2 pounds
Total	100 pounds

Melt the copper and the manganese-copper together under charcoal; when liquid stir thoroughly, add the aluminum, stir a second time, add the warmed zinc gradually, and stir again, ingot the alloy and remelt for castings.

Fluxes for Ingot Metal

We have been informed that in making leaded alloys a flux of plaster of paris and borax is used up to 2 per cent, and also roll sulphur up to 0.50 per cent. We are making an alloy of copper 80 per cent; tin, 10 per cent; lead, 8 per cent; zinc, 2 per cent, with phosphorus up to 0.75 per cent replacing copper. We are making ingots and have been advised that a flux of fluor spar and lime will make the metal flow freely. Kindly advise us if this is so, or if we would do better to use the borax, plaster of paris and roll sulphur? And if so in what proportions? Also, is a flux consisting of 2 parts fluor spar and 1 part borax used as a deoxidizing agent?

The plaster of paris, borax and sulphur is only used to hold the lead in a mixture containing approximately 50 lead and 50 copper, with or without tin. While the borax and plaster of paris would do no particular harm to the mixture given in the query, the sulphur would be harmful, and must be kept out at all costs or the castings will be spongy. It is for this purpose that fluxes are used, the molten metal must be protected from the oxygen and the sulphur in the furnace atmosphere, either existing free or combined. With the alloy in question no flux is required other than charcoal but if a flux is to be used a mixture of boneash, sand and charcoal will be the best, as lime would flux out the phosphorus. A mixture of fluor spar and borax will not *deoxidize* but it would make a fluid cover. This would have to be thickened with lime and then it would remove the phosphorus.

Spongy Castings May Be Due to Hot Sand

We have experienced considerable difficulty in our foundry from porous castings. We use an alloy consisting of copper, 85 per cent, tin 5 per cent, lead 5 per cent, and zinc, 5 per cent. The castings are the usual line of red brass plumbing supplies and valves up to 2 inches. We melt our own turnings, charging then about 25 pounds to a heat into crucibles which are heated in oil-fired pit furnaces. The remainder of the heat is made up of scrap copper and the white metals required. We use a foundry flux with the metal, mixing it with the turnings. The metal does not appear to be too hot, and the castings machine freely and have a good grain and color when finished. Our foundry recently was burned and we have been obliged to use considerable new sand which we think may be responsible for this trouble, as the castings invariably come spongy on the cope side. We shall be grateful for any suggestions you may offer covering this difficulty.

In offering suggestions for overcoming this difficulty, consider first the melting. It is good practice to use turnings with each heat, *provided* the amount of turnings used is not so large that they crowd the copper out of the crucible making it necessary to add cold copper to the melted charge later. When this occurs, it is often the practice to place the ingots of copper on the side of the crucible so they will get heated, and melt better afterwards. This is bad practice and the fact of its being usually done does not mean anything in its favor. The best conditions in melting prevail when all

the copper and scrap portion of the charge is placed in the crucible cold, then is topped with a few blocks of hard wood or some charcoal which is renewed as it burns away.

It is not possible to get all the charge into the crucible in a solid state, unless a hopper is placed on the top of the crucible. This hopper is made by chopping the bottom off worn out crucibles with a common hatchet. This forms an important melting adjunct.

The trouble may be that oil-fired furnaces may be too shallow to allow this hopper to be placed. Some means should be discovered of using these hoppers, then regulate the amount of turnings, so that no copper or other part of the charge is crowded out. Melt all together and when the charge is liquid, remove the hopper. Place the turnings in the bottom of the pot without any admixture of fluxes, except a little charcoal or sawdust dampened with salt water. Fluxes are objectionable in foundry melting operations if they are fluid, or if they attack the crucibles. In the first condition they cannot be held back when pouring the brass and so run into the castings. In the second they are costly in crucibles. Charcoal is too light to stay on the top of the metal when melted in oil-fired furnaces but some covering is required. Use any commercial foundry flux that will cover the metal and be free from the objections stated, but do not mix it with the borings unless an analysis shows that it will not be harmful. Careful melting most probably will remove this difficulty.

Now consider the molding operations. New sand will not produce spongy castings, provided it is not too damp or too close. However, insufficiency of sand in the molders' piles often does cause this trouble. Do not allow hot sand to be used to ram molds, even if it is backed by cool sand. Have plenty of sand so every molder has cold sand to make his entire heat; otherwise, the heat in the sand will produce steam in the molds waiting to be poured which will condense on the cores and result in spongy or porous castings.

Suggested Changes in Risers and Heads

BY BEN SHAW

IN CARRYING a head or riser on any casting advantage is taken of the tendency that causes any dirt which may be carried through the runners with the metal to rise to the surface or the highest point in the mold. Since the extra metal is carried at this point, the dirt probably will rise into the metal which does not form a part of the finished casting. However, this is not the only advantage to be derived from the use of a riser. Metal, when molten, is similar to other liquids and liquid pressure exists in all molds. Therefore, the metal forming the lower part of a casting will consist of denser metal than that of the upper part through the action of liquid pressure.

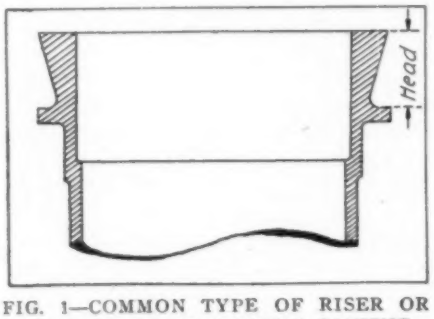


FIG. 1—COMMON TYPE OF RISER OR HEAD ON A CYLINDRICAL CASTING

It is because of this elementary fact that a casting upon which a head has been used, other things being equal, will consist of metal having a closer texture than otherwise would be the case. The head provides a reservoir of liquid metal from which the casting proper may draw to make up for shrinkage losses. Heads are particularly useful on cylindrical work, especially when the castings are to withstand high pressures. A cylinder liner is such a type of casting, upon which it is customary to cast a head.

The height and particular shape of the additional metal varies considerably in different foundries but a common form is shown in Fig. 1. Whatever shape of head is adopted, it invariably increases in thickness from the casting to the top of the head. The metal thickness is graduated to minimize the strain in the casting and at the same time to give a substantial body of metal as a head. The usual practice is to cast these heads continuous with the circular top of the work, and no matter how the sectional shape may be graduated to reduce unequal contraction, considerable strain always exists in the finished casting at the line of junction. This is in evidence in liners, so much so that it is common practice to take a roughing cut from the casting after the head has been removed and allow it to stand some time before the final cut is taken, to enable the casting to readjust itself and eliminate the strains.

How to Avoid Excessive Strains

The strains in the top of a casting, due to the slower rate of cooling of the metal forming the head, can be eliminated almost entirely without such waste of time by breaking the continuity of the head. The method is illustrated in Fig. 2. A number of prints are located when sweeping the mold or else are attached to a wood or loam pattern so that cores may be inserted to divide the head. The number of cores used may be either four or six depending upon the size of the job. The value of the head to the casting is not reduced in any way, but by separating it, each section has independent action while cooling.

While the use of a large body of metal is excusable when dealing with a comparatively cheap material such as cast iron, this type of head, unless the circumstances are exceptional, is not used for castings composed of the more expensive alloys, such as gun metal, etc., because of the relatively greater cost of melting and the loss of metal.

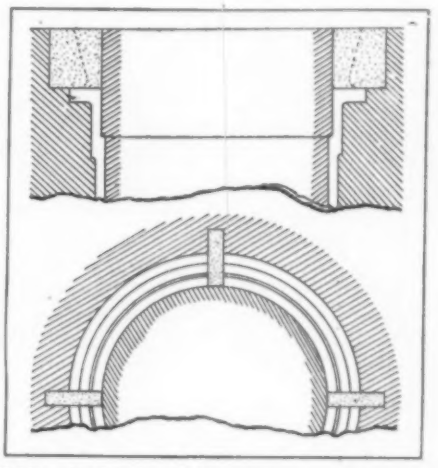


FIG. 2—THE CONTINUITY OF THE HEAD MAY BE BROKEN BY CORES

When conditions are exceptional, a prepared runner, made in the form of a ladle or reservoir similar to the type used for pouring steel is particularly useful. The metal is poured into this reservoir until it contains more than is required for the casting. Then a ball valve in the runner is lifted to allow the metal to enter the mold. A considerable amount of metal is allowed to remain in the reservoir until the casting has been fed. Then the surplus metal is tapped off into a more convenient form for breaking up.

The advantages obtained from this

method include the thorough mixing of the metal; the opportunity for dross to rise to the surface before any metal enters the mold; the considerable liquid pressure exerted upon the metal forming the casting; and the reduction in oxidation due to the smaller surface exposed to the air. However, the method is expensive and its use is limited to special work.

A method which possesses many of the advantages of the head used in connection with iron casting, is illustrated in Fig. 3. This type of head is particularly useful for gun metal liners and bushings and it has the advantage of being economical in its use of metal. By reference to Fig. 3, it will be noted that a covered runner is prepared and this is connected with the mold by a series of gates. Frequently, in work of this character, the metal is supplied to the bottom of the mold and the head becomes a riser. It depends largely upon individual practice and the composition of the metal to be cast whether the metal is supplied by way of the top or bottom of the mold.

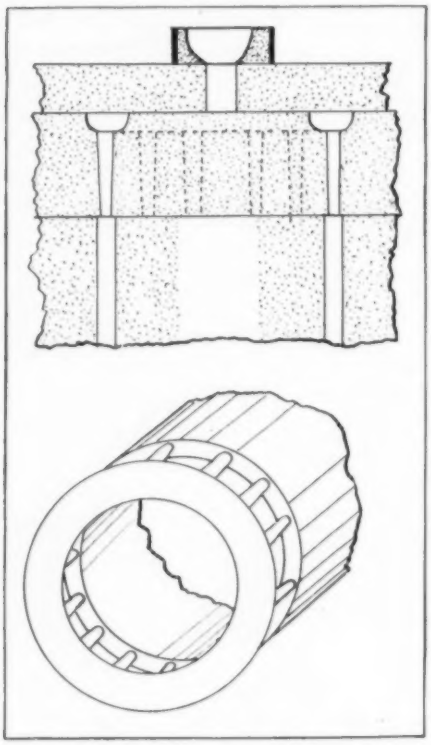
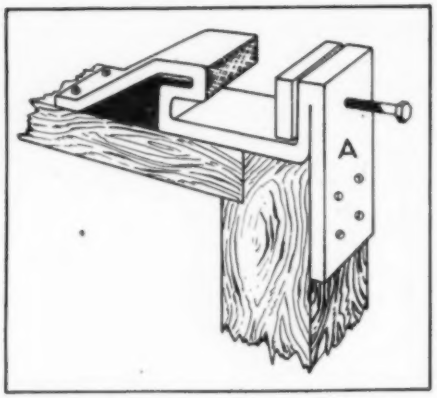


FIG. 3—SPECIAL COVERED RUNNER WHICH MAY BE USED FOR A RISER

A Handy Home Made Vise

By F. H. Sweet

The small bench vise shown in the accompanying illustration can be made by any mechanic from a strip of ⅜-inch flat iron 2 inches wide; a short section of the same material for a movable jaw and a common ⅝-inch bolt. The strip of iron is heated in the forge and bent to the desired shape after which the hole is drilled and tapped for the ⅝-bolt as shown at *A*. Four smaller holes are drilled through the upright part and two through the back end to afford a means of fastening it to the wooden support or bench.



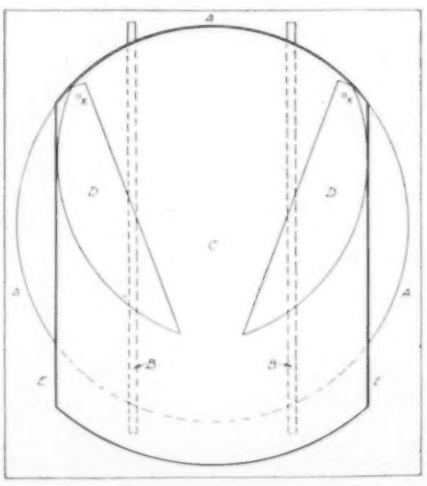
METHOD OF ATTACHING VISE

Utilizing the Waste Heat from the Cupola

By Joseph McGinnis

A device for heating the shop during the night from heat given off by the cupola "drop" is shown in the accompanying illustration. The circle *AAA* represents the inside of the cupola lining; *B B* are ¾ x ½-inch iron bars made long enough to reach across the cupola and fit in notches cut in the lining; *C* is a sheet-iron plate slightly narrower than the charging door frame. The later has straight sides and rounded ends. The two wings *D D* are made of the same material as the plate *C* and are attached to it at one end by the bolts *X X*. The sides of the charging door frame are indicated by *E E*.

After the cupola bottom has been dropped the bars *B B* are put in place, the plate *C* is then pushed across until it touches the back wall, then the wings *D D* are swung out to touch the lining on the sides. This arrangement acts as a damper in the stack and prevents the heat from escaping.



THE DEVICE IN PLACE

Book Review

General Foundry Practice, by Andrew McWilliam, A.R.S.M., D. Met., and Percy Longmuir, D. Met.; M.B.E.; cloth 6½ x 9 inches; published by Charles Griffin & Company, Limited, London, England, and furnished by THE FOUNDRY for $6 net. The joint authors of this work which now appears in a third and revised edition have been prominent figures in the foundry industry for many years. Andrew McWilliam at present consulting metallurgist, formerly was metallurgical inspector for the government of India. Percy Longmuir is a Carnegie medallist and former president of the British Foundrymen's association.

This work is designed to give a condensed account of the science and practice of iron and brass founding in such a way that it may prove of the greatest benefit to all connected with the production of castings. The field is an extensive one; but so far as possible the authors have drawn from their combined experience gained under normal foundry conditions and under the conditions of experimental laboratories and works. Practically every operation described has been personally followed and the spirit of the book will be found to reflect the experience of actual workers and not merely spectators.

Although primarily intended for foundry managers and foremen or those who aspire to these positions, the book will be found of assistance to molders and apprentices who desire a fuller knowledge of the trade. Much of the subject matter is of interest and value to the engineer and designer as well as to the student of general metallurgy. The subject matter is treated under 38 chapter heads as follows: Introduction, general properties of matter, molding sand, facing sands and facing, securing core in molds, molding, handling material in the foundry, open sand molding, cores, elementary aspects of molding, green sand molding, securing cores in molds, molding from guides, bench, odd side and plate molding, machine molding, dry sand molding, loam molding, chill casting, casting on to other metals, burning, weighting and binding molds, shrinkage, contraction and warping, cleaning castings, common faults due to mold and pattern, malleable or wrought iron, steel, cast iron and malleable cast iron, refractory materials, fuels and furnaces, mixing by analysis, influence of remelting, working the cupola, high temperature measurement, steel, notes on metals other than iron, alloys, mechanical testing,

micrographic analysis, common faults due to the metal, notes on foundry management.

The book is written from the British viewpoint and the British standard for tables of weights and currency is employed throughout. However since the basic principles underlying foundry practice are identical every place the book will be valuable to any person who speaks, reads or understands the English language.

Patterns Which Reduce Foundry Expense

BY M. E. DUGGAN

THE pattern shown in the accompanying illustration is one which started a debate between some patternmakers and machinists a short time ago. The job is so simple that I am somewhat ashamed to present it; however, before you have finished reading the description you may have occasion to do a little thinking on your own account.

Two iron castings were wanted, for which a pattern was required to be made. A blue print was sent to a pouring shop some 15 miles away. The pattern was made and delivered but upon inspection it was found to have been made in two halves. It was split through the middle on the line A-B, Fig. 1, and each half was so badly warped and twisted that a little repairing was necessary to bring it back to its original shape. It was the warped and twisted condition of the pattern that started the noon hour discussion and it ended with an argument on the part of the patternmakers present as to just how the piece would be molded.

One offered the following as the patternmakers' reason for making a split pattern: "One-half of the pattern is placed in position on a board, the drag set on, rammed and rolled over; then the other half is placed and the cope rammed. This makes easy work for the molder," said he.

As only two castings were wanted the question naturally arose, why go to the trouble and expense of splitting the pattern, why not make it solid and cast it on its side? One admitted that it would make a little more trouble for the molder, but why should any person worry about him, he would be sure to find a way out. That is simply a case of passing the buck and is an evidence that the man knew little of the one thing that makes any patternmaker a practical mechanic and that is a knowledge of molding practice. If I were in his place I think I would make it my business to learn from the molder who made my job where my pattern was at fault and in what way it caused him trouble. In that way a similar mistake would not be so likely to occur again. Passing the buck to the molder is not the way to become a competent patternmaker.

Many Men of Many Minds

A third thought the pattern should be made solid and molded on end, Fig. 3, because the whole pattern could then be molded in the drag. In other words neither of these three patternmakers was quite sure that his was the correct way for making the pattern and molding this little simple pattern.

The discussion was then turned to the hole in the hub. This was a finished hole 1¼ inches in diameter. The following questions were put to the patternmakers but the answers they returned were all just guess: Why is this casting made with a cored hole in the hub? Is it done to save in weight or is it a help to the machinist in finishing the hole? What finish allowance would you provide if the casting was to be made in iron; in brass; in steel? Is it worth while making a corebox for a 1-inch diameter core when only two castings are wanted? Suppose the coreprint was an odd size would you make a special corebox? If the cope coreprint was tapered would it be necessary to make the end of the corebox tapered? If the core was made perfectly straight how would the molder make it fit the tapered print? Would it take the molder as long to taper two cores as it would the patternmaker to put a tapered end on the corebox? If the cope coreprint was dispensed with could the core be held accurately in the mold?

"When but one or two castings are wanted, which way do you prefer them made, cored or solid hub?" This was one of the questions asked the machinists and the answers to these simple questions by both patternmakers and machinists indicated that their knowledge of foundry practice was limited. As a conclusion it may be interesting to know that when the split pattern reached the foundry the molder nailed it together and molded it on end as shown in Fig. 3.

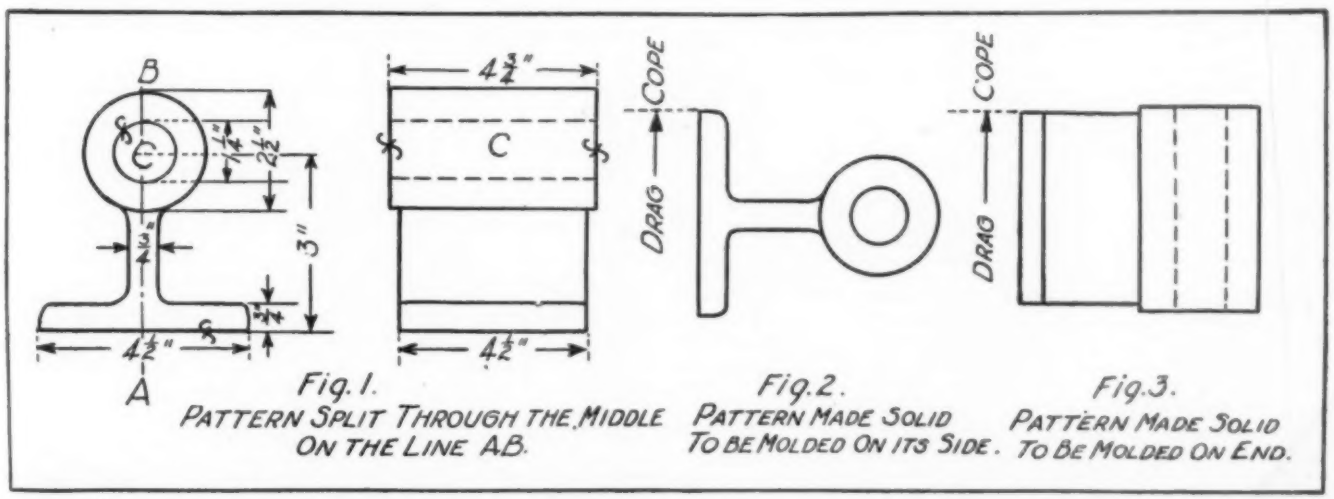


Fig. 1. PATTERN SPLIT THROUGH THE MIDDLE ON THE LINE A.B.

Fig. 2. PATTERN MADE SOLID TO BE MOLDED ON ITS SIDE.

Fig. 3. PATTERN MADE SOLID TO BE MOLDED ON END.

FIG. 1—PATTERN SPLIT THROUGH THE MIDDLE ON THE LINE *A-B* FIG. 2—PATTERN MADE SOLID TO BE MOLDED ON ITS SIDE FIG. 3—PATTERN MADE SOLID TO MOLD ON END

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High Record Reached in Iron Production

PIG iron production constitutes a true barometer of general industrial conditions. It also is a measure of manufacturing accomplishment. These facts never were better attested than during the past year when practically every industry was operating at top speed and the transportation facilities of the country were unable to keep pace with the demands for shipment of raw materials and finished products. This is reflected in the tables showing the production of various grades of pig iron, recently issued by the American Iron and Steel institute. The total of pig iron of all grades produced in 1920 was 36,925,987 tons, exceeding by 5,910,623 tons the previous year's output and far outstripping any previous year excepting only those years when wartime necessity brought the totals to record levels.

Last year's production of foundry iron and ferrosilicon, which are grouped together in the Institute report, established a high mark. A total of 5,957,782 tons of foundry iron was made. This exceeds the 1919 figure of 4,916,758 tons by 1,041,024 tons or 21.17 per cent. In 1920, the foundry grades formed 16.13 per cent of the total iron produced, while the preceding year they composed 15.85 per cent of the total. Previous to 1920, the greatest tonnage of foundry iron was made in 1916 when 5,553,644 tons were made under stress of the construction activities that marked the climax of prewar industrial preparation.

Malleable iron has kept step with foundry iron. The 1920 total was 1,310,951 tons as compared with 1,009,049 tons for the previous year. This marks an increase of 301,902 or 29.92 per cent. Malleable iron formed 3.55 per cent of the total in 1920 and 3.25 per cent in 1919.

Internal Strains Affect Castings

HIGH tensile strength rightly is concluded to be beneficial to the average run of gray iron castings, but not enough is known of the limitations of this product under all conditions. Unlike steel, its resistance to shock cannot be determined by an elongation test and the deflection of cast iron under transverse strain seldom is determined. Even when determined, the deflection of a bar 12 inches between supports is so small that testing variations enter into the results too strongly. Undoubtedly, the higher the strength of the metal, the more resistance it will have to shock unless the internal strains caused by high combined carbon or excessive shrinkage overbalance the gain of high tensile strength. More light should be had on the effect of shrinkage on the strength of castings and the relative effect of this shrinkage on gray iron and semisteel in the same kinds of castings. Possibly some doubts about the adaptability of semisteel under certain conditions then could be proved or disproved. Tests taken from the center of heavy castings would give an indication of the result of internal strain on the various classes of metal and tests taken at the juncture of light and heavy sections would indicate the lowest strength of the metal in the casting, which after all is the governing factor. A thorough research along this line would be illuminating and might bring out data of value to the foundryman as well as to the designing engineer and the user of castings. It could not fail to be of value.

Trade Outlook of the Foundry Industry

WHILE no evidences yet have appeared to justify the assumption, a general feeling is prevalent that the bottom has been reached in the industrial depression, and that the rebound may be expected shortly. The slight improvement which was noted a few weeks ago has been succeeded in many sections by almost complete stagnation. Foundries in the East which had increased their weekly schedules, again have dropped back, while through the Mid-West and South still further retrenchment has been noted in plant operation.

Climax Approached

While the economic adjustment, which has been under way for months is not completed, a better balance is noted between the prices of commodities in general. A slight betterment is noted in some lines which were among the first to drop rapidly and steadily to points below what is considered an average level. At the same time, some other materials, which were slow to react under the general decline, now have fallen to a point where little change is noted. Production has dropped to a point far below normal consumption in almost every line of manufacture. At the same time, the buying of raw and semifinished materials has not kept pace with the decreasing production. Manufacturers have been buying in a hand-to-mouth fashion, and reserves which are carried in normal times have dwindled to a minimum. An instance is cited of one foundry and machine shop interest that uses a great number of bolts. The shop superintendent presented a requisition for 50,000 bolts. At the instance of the management this was cut down to 2500, which under normal operating conditions would be less than one week's supply. That same condition governs largely throughout the foundry industry. Shipments of metals and fuel have been held up for several months, and even under the part time operation, few plants maintain over 60 days' supply of coke and iron.

Prices of Raw Materials for Foundry Use

CORRECTED TO MARCH 23

Iron		Scrap	
No. 2 Foundry, Valley	$25.00 to 26.00	Heavy melting steel, Valley	$13.50 to 14.00
No. 2 Southern, Birmingham	26.50 to 27.00	Heavy melting steel, Pitts.	13.00 to 14.00
No. 2 Foundry, Chicago	25.00 to 27.00	Heavy melting steel, Chicago	11.50 to 12.00
No. 2 Foundry, Philadelphia	25.34 to 28.54	Stove plate, Chicago	16.50 to 17.00
Basic, Valley	25.00	No. 1 cast, Chicago	16.50 to 17.00
Malleable, Chicago	25.00 to 27.50	No. 1 cast, Philadelphia	20.00 to 21.00
Malleable, Buffalo	27.50 to 29.50	No. 1 cast, Birmingham	21.00 to 23.00
Coke		Car wheels, iron, Pittsburgh	20.00 to 21.00
Connellsville foundry coke	$5.00 to 6.00	Car wheels, iron, Chicago	14.50 to 15.00
Wise county foundry coke	6.50 to 8.50	Railroad malleable, Chicago	14.50 to 15.00
		Agricultural malle., Chicago	14.50 to 15.00

Some Rifts Noted

During the week of March 21, some few indications of betterment have arisen. Although confined to small lots, movement has appeared in the pig iron market in the Chicago district and through New England. This is coincident with reports of an increase in inquiries and better character of inquiries received by foundries through the middle western and eastern states. Up to the past few weeks the usual inquiry received in the foundry office has been more expressive of academic interest than buying inclination. At present buyers not only are seeking general information, but are specifying quantities and delivery dates in their requests for prices. Operating conditions have not yet been affected. Improvement in some centers has been offset by losses in others. The condition in St. Louis is typical. Here jobbing foundries have been increasing production, rehiring a few more men, and buying small amounts of iron. On the other hand, stove manufacturers and makers of castings for the implement trades are restricting operations. The latter largely are dependent upon the southern markets, which are supported by the requirements of rural communities and in this case are particularly hard hit. An exception is noted in one large St. Louis establishment making sugar mill machinery which now is working 24 hours a day. Southern Ohio reports some improvement in machine tool lines and in the stove foundry business. With the possible exception of the region immediately surrounding New York City, foundry conditions in the East are not as promising as they were a few weeks ago. Most of the shops are operating from three to five days a week, and with reduced forces. Probable conditions in the automotive industry still can not be determined with any satisfaction. A few of the larger manufacturers have resumed operations under restricted schedules; sales are reportd to be improving with the advance of the season; but no demand for castings has developed. As has been pointed out previously, large stocks of castings are to be found either in the foundries or the automobile factories. One Detroit plant has at its command over 50,000 cylinder blocks; another has more than this number of aluminum crank cases. Under present conditions these would suffice for practically two years' operation. One favorable factor has been noted in the past week which will affect mainly those foundries which make miscellaneous small castings for automobiles and trucks. During the rush of production last fall, little attention was given to keeping up parts stocks. At present a number of the large companies are directing their attention to replenishing these parts and are specifying for castings for this purpose. Railway buying has not developed, nor is it likely to do so until freight business improves and operating expenses are decreased. Money which recently has become available to the roads from the government has been applied largely in meeting past obligations, and it is asserted that nothing but replacement and repair buying may be expected in the near future. Freight movement continues to decline.

Nonferrous Slack

Restrictions upon building construction have reacted upon the brass foundries and but little business is at hand. Nonferrous metal prices, based upon New York quotations in *Daily Metal Trade* for March 23, follow: Casting copper 11.62½c to 11.75c; Lake copper, 12.50c; lead, 4.25c to 4.30c; Straits tin, 29.00c; antimony, 5.50c; aluminum, No. 12 alloy, producers' price, 27.00c, and open market, 18.50c to 20.50c. Zinc is 4.70c, E. St. Louis.

Comings and Goings of Foundrymen

ROBERT CAMPBELL, at one time a foundryman in the Gadsden, Ala. district, has returned to the United States after two years in Scotland, where he built two soil pipe plants at Berwick-on-the-Tweed. He is purchasing machinery for shipment to Scotland and expects to return to build other pipe plants on the American plan.

C. J. Hauck has been made foundry superintendent of the Vulcan Iron Works, Denver, Colo.

George Glassmeier recently has been promoted to be foreman of the Newark Stamping & Foundry Co., Newark, O.

Wendall C. Swain has been made foundry foreman for the Concord Foundry & Machine Co., Concord, N. H.

Stewart Bolling has been placed in charge of the new Cleveland offices of the Southwark Foundry & Machine Co., Philadelphia.

Albert Whitmore has been placed in charge of the finishing department of the Sharon plant of the National Malleable Castings Co., Sharon, Pa.

E. P. Grismer has been placed in charge of offices opened at 419 Bangor building Cleveland, by the Steward Mfg. Corp., die molded castings and bronze back bearings.

Carlton R. Dodge has been selected as western sales manager for the Lakewood Engineering Co., Lakewood, O. Mr. Dodge will have head-quarters at 1215 Lumber Exchange Bldg., Chicago.

James R. Lowe has been made general sales manager for the Harrisburg Foundry & Machine Works, Harrisburg, Pa. Mr. Lowe formerly was connected with the Midwest Engine Co., Anderson, Ind.

Charles Taggart recently accepted a position with the Dominion Steel Foundry Co., Hamilton, Ont., Canada. Mr. Taggart for the past 20 years has been foreman of the plant finishing department of the National Malleable Castings Co., Sharon, Pa.

Henry Hoeltge has been appointed advertising manager for the Central Foundry Co., 90 West St., New York. Mr. Hoeltge, who until recently was western advertising manager for the *Plumbers Trade Journal, Steam and Hot Water Fitters' Review*, was previously connected with the Central Foundry Co.

Pliny G. Morrison recently has been elected general manager and treasurer of the Concord Foundry & Machine Co., Concord, N. H. succeeding Ralph G. Benjamin who resigned to become manager of the Ford & Kimball Foundry of that city.

Henry Clouture has been appointed supervisor of stores and materials of the Belcher-Taylor division of the Bateman Cos., Inc., Chicopee Falls, Mass., builder of agricultural implements. He is president of the board of alderman of that city.

Walter F. Graham now is connected with the Henry Souther Engineering Co., Hartford, Conn. Mr. Graham formerly was metallurgist for the Spicer Mfg. Co., Plainfield, N. J. and previous to that time with the Ferro Foundry & Machine Co., Cleveland, the Ingersoll-Rand Co., New York and the Standard Roller Bearing Co.

D. G. Anderson who recently has been made general manager of the Ashland Malleable Iron Co., Ashland, O., at present is engaged in completing new furnaces and equipping the new plant. Mr. Anderson formerly was connected with the Malleable Iron Fittings Co., Branford, Conn., the Ohio Malleable Iron Co. Columbus, O., and the Ohio Brass Co., Mansfield, O.

D. M. King, of Glasgow, Norman Cockburn, of Edinburg, and A. W. Stevens, of Polmont, representing an association of cost iron soil pipe manufacturers of Scotland, with Robert Campbell, of Gadsden, Ala., who has been building pipe plants in Scotland for the past two years, visited the various foundries and pipe plants in the Alabama district during March. They are visiting foundries that specialize in making castings of this character with a view of incorporating the best and latest American foundry practice in their present plants and also in those which they propose building.

Institute of Metals Holds Meeting

The annual general meeting of the Institute of Metals of Great Britain was held in London March 9 and 10. On the second day an inspection trip was made to the national physical laboratory. The following papers were read at the sessions:

Stages in the Re-Crystalization of Aluminum Sheet on Heating, by Prof. H. C. H. Carpenter and Constance F. Elam; Some Notes on Calcium, by P. H. Brace, East Pittsburgh, Pa.; Plastic Deformation of some Copper Alloys at Elevated Temperatures, by Prof. C. A. Edwards and A. M. Herbert; The Action of Reducing Gases on Heated Copper, by H. Moore and S. Beckinsale; The Season Cracking of Brass and Other Copper Alloys, by H. Moore, S. Beckinsale and Clarice E. Mallinson; The Constitution of the Alloys of Copper with Tin, Parts 3 and 4, by J. L. Haughton.

The May lecture to be delivered at the Institute of Mechanical Engineers on May 4, by Prof. T. Turner, Birmingham University, will be entitled, "The Casting of Metals."

New Foundry Is Operating

Iron is being poured in the new foundry of the Fremont Casting Co., Worcester, Mass., a subsidiary of the Curtis & Marble Machine Co. The building was remodeled from a building operated as a power house by the Worcester Consolidated Street Railway Co. Herbert A. Davis, formerly of the Crompton & Knowles Loom Works and the Hendy Machine Co., Torrington, Conn., is superintendent of the plant and Harry W. Wilbur is office manager.

Designs New Type of Sand Cutting Machine

The sand cutting and riddling machine shown in the accompanying illustration recently has been completed by the Whiting Corp., Harvey, Ill., and is now undergoing a series of tests before being placed on the market. It is designed to cut, aerate, screen and temper molding sand at one operation.

After the flasks have been shaken out and the castings removed the sand is wet down and allowed to cool. The sand cutting machine then is brought into action and driven from one end of the sand pile to the other. A series of rapidly revolving blades cut and aerate the sand and at the same time throw it toward the center of the machine where it is gathered by the bucket elevator and conveyed to the revolving screen. The screen completes the mixing process and at the same time removes all foreign material, gaggers, wedges, scrap, broken cores, etc. and deposits the clean sand in a windrow beneath the machine, ready for the molder's use. It is claimed that under

ordinary operating conditions the machine is capable of handling one cubic yard of sand a minute.

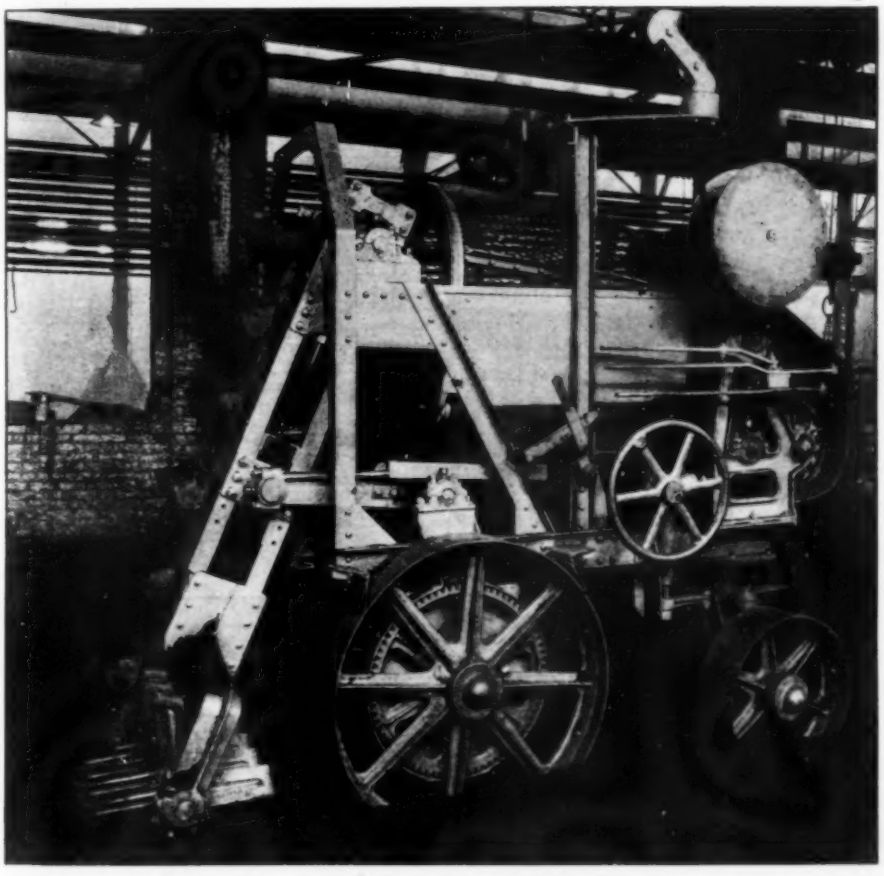
The machine is adapted to be driven either by a gasoline engine or an electric motor and is capable of developing two cutting speeds selectively engaged by a jaw clutch. As will be noted by reference to the illustration, all features of design and construction have been worked out with a view to permanence and efficiency.

Lift Truck Finds Many Uses in Foundry

A lift truck and separable loading platform to be used in connection with it, both made by the Terminal Engineering Co., 17 West 44th street, New York, are shown in the accompanying illustration. The platforms are of large area and are raised and lowered by screw lifting jacks. It is claimed that all loading and unloading delays are eliminated and the truck can be kept working constantly.

The truck is equally adaptable indoors or out. The tire equipment, method of spring support and weather-proof design motors enable it to run over ordinary city streets, while its 4-wheel drive and steer lends itself readily to easy handling in the crowded conditions frequently prevailing indoors. Goods loaded on one of the platforms can be transferred from any floor of one building to any floor of another building without re-handling.

Another advantage claimed for this style of truck is that a large variety of special equipment may be used in connection with the separable platform. The illustration shows a roller dump body mounted in this manner. This body has a capacity of 2½ cubic yards and is adapted for use around the foundry for hauling coal, coke, sand, ashes, etc. When not engaged in this kind of transportation the dump body can be removed and the ordinary platform substituted. It then can be used for handling castings between the different departments, also patterns, flasks, cores and other materials which constantly are being moved from one point to another.



THE REVOLVING BLADES IN FRONT CUT THE SAND INTO A PILE WHERE IT IS PICKED UP BY THE BUCKET ELEVATOR AND DISCHARGED INTO A REVOLVING SCREEN—THE MIXED AND RIDDLED SAND IS DISCHARGED IN A LONG WINDROW UNDER THE MACHINE AS IT TRAVELS FORWARD

Makes Tea Pot Spout Type of Foundry Ladles

A recently improved design teapot spout ladle is shown in the accompanying illustration. It will be noted that the spout is formed in the ganister lining inside the bowl. This allows the trunnions to be placed nearer the center line of the shell thus insuring better balance and easier handling for pouring. The bowl of this ladle is all in one piece riveted construction and therefore is not likely to warp out of shape after continued usage. This type of ladle may be lined with either brick or ganister. The latter is somewhat easier to form. It is manufactured by the Whiting Corp., Harvey, Ill., in 12 standard sizes, capacities ranging from 700 to 10,500 pounds in steel.

THE SEPARABLE LOADING PLATFORM SUPPLIED WITH THE TRUCK MAY BE ADAPTED TO MANY USES INCLUDING THAT SHOWN

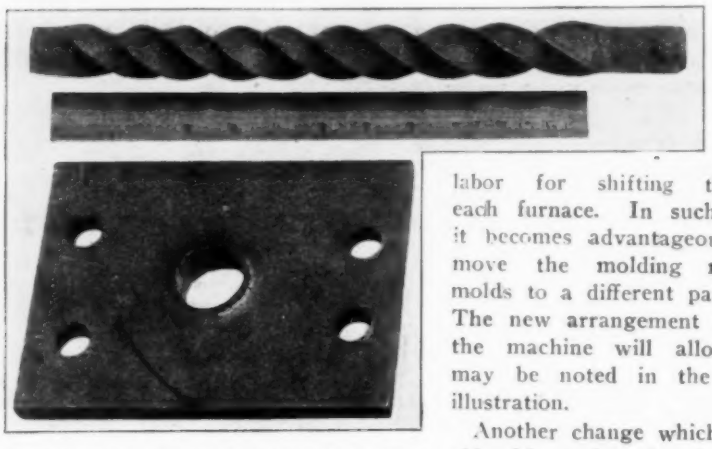
Acquaint Railroad Men with Malleable Castings

The American Malleable Castings association was one of the large exhibitors at the annual exhibit of the National Railway Appliances association held at the Coliseum, Chicago, from March 14 to 17 inclusive. A complete collection of castings for railway purposes was furnished by members of the Malleable association specializing in this class work.

In addition to this exhibit, a working demonstration was given to acquaint visiting railway men with the

TWO UPRIGHT ANGLE IRON SUPPORTS ON THE INSIDE HELP TO FORM THE BRICK OR GANISTER MADE SPOUT

properties of malleable castings. For this purpose, a suitable punch press had been installed and was operated by an experienced operator. A supply of ⅝-inch cast-iron plates was provided. They were punched with a ¾-inch hole and the holes were drifted



PUNCHED PLATE AND BAR EXHIBITED BY THE MALLEABLE ASSOCIATION—THE BAR WAS TWISTED THROUGH 800 DEGREES

until the diameter was increased to 1½ inches without injury to the plate.

A torsion machine also was in operation to demonstrate the resistance of malleable castings to repeated strains. This torsion machine was used to twist test bars which were 1 x ¾ inch in cross section. The operator twisted these bars three times through 180 degrees and after each twist straightened it to the original form. Each bar was then twisted until fractured after a complete turn. Another test consisted in twisting a bar through 800 degrees without fracture.

To demonstrate that malleable castings do not depend solely upon the strength of the outer surface, certain test bars of standard diameter were tested under similar conditions with other test bars of larger diameters which had been turned down to the Standard diameter. Those which had the outer skin removed were practically as strong as those which were tested in their original condition as they came from the anneal.

Changes Made in Design of Molding Machine

Some of the changes made in the Howe-Tector suspended-type molding machine since its first inception are shown in the accompanying illustration. Probably the most important change is the pivoting of the air legs so that they may be thrown into a horizontial position providing clearance for moving themselves over molds which have already been placed. This feature is of great value in practically all malleable iron plants When heats are taken off twice every day from several furnaces, it is necessary to so arrange the time of heats on the various furnaces that they will come off at intervals of not less than 45 to 60 minutes apart, so as to have available the necessary amount of labor for shifting the molds on each furnace. In such circumstances it becomes advantageous at times to move the molding machines over molds to a different part of the floor. The new arrangement of the legs of the machine will allow of this as may be noted in the accompanying illustration.

Another change which also has considerable value is the arrangement of the side bench so it is now entirely removed from the floor and is supported from the column of the machine by rigid brackets. This makes it possible to have the bottom boards piled direct under the side bench, close at hand for the molder.

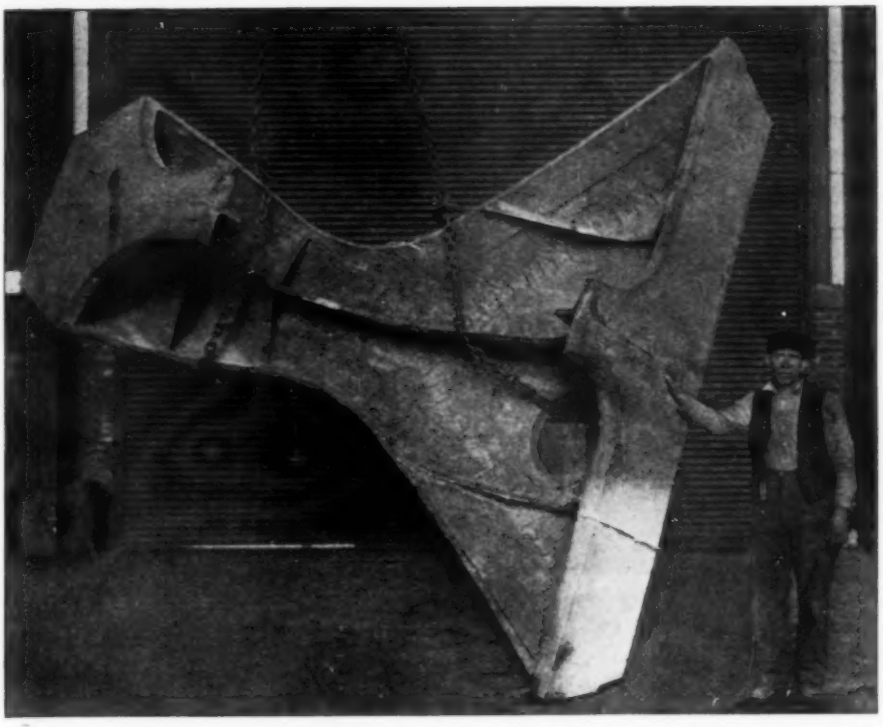
The third feature is the swinging riddle shelf which eliminates all effort on the molder's part due to lifting the riddle. The riddle slides back and fourth in the angle frame, shaking the sand on the pattern. When the mold is complete, a push of the finger sends the shelf out of the way.

The fourth improvement is one which has value in certain plants, but not in others. It is the reversing arrangement of the trolley. The machine is so mounted that it is pivoted directly above its center of gravity and locked in this position with a hand lever. To reverse the machine the hand lever is pulled down and the machine spun around through 180 degrees and locked in this position again by the hand lever which engages a hook on the trolley. In certain malleable plants it has been found advantageous to operate the machine in one direction in the morning and reverse it for the afternoon's work, the object being to facilitate the use of the sand cutter and to enable the molder to have cold sand throughout the day, with the minimum supply of sand on his floor necessary to accomplish this result.

Heavy Castings Poured at Navy Yards

Battleships require a number of large and complicated castings, therefore the navy yards become accustomed to producing such work. The accompanying illustration shows a fair water casting for the NORTH CAROLINA, a 42,000-ton battleship now being built at the Norfolk navy yards. The casting weighs 15,000 pounds, and to secure enough metal 18,000 pounds of scrap were charged into the 6-ton Greaves-Etchells electric furnace at the foundry of the Norfolk navy yards. A small cupola was run at the same time to furnish iron to

WHEN THE LEGS ARE RAISED AND TURNED THE MACHINE CAN EASILY PASS OVER A FLOOR OF MOLDS



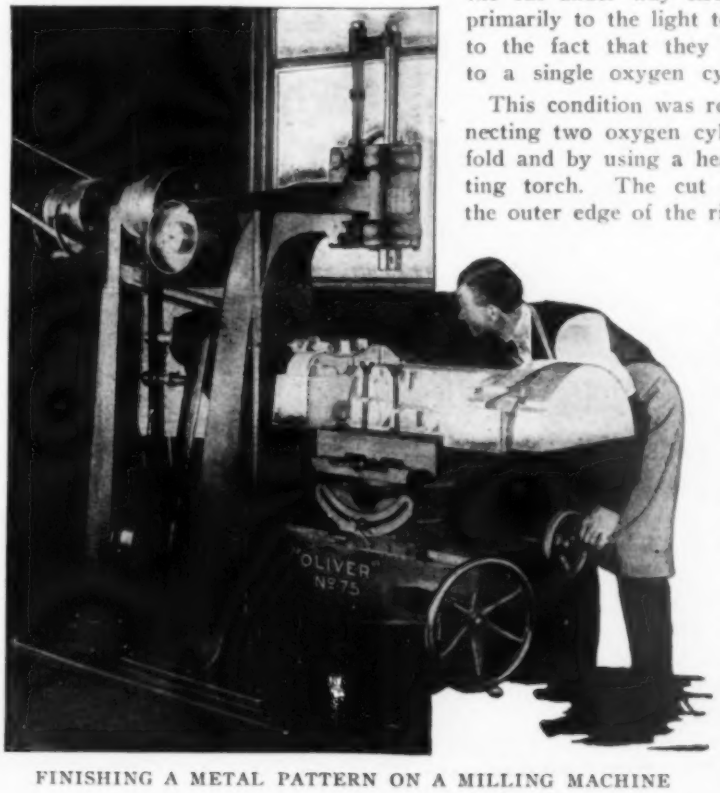
HEAVY STEEL CASTING POURED AT NAVY YARD

fill the risers, which were rather deep, in case enough steel was not available. The iron proved unnecessary as the risers were completely filled with the steel from the ladle. An 8-ton bottom-pour ladle was used. An inch of the lining was first chipped out all around to enable the ladle to hold more metal. All the metal from the furnace was poured into the ladle with the exception of 400 pounds which remained in the furnace. About 700 pounds of metal was left in the ladle after pouring. Thus approximately 17,000 pounds of steel were needed for the casting and risers.

The specifications for the casting called for a tensile strength of not less than 60,000 pounds per square inch and an elongation of 22 per cent in 2 inches. Tests of the steel showed a tensile strength of 85,000 pounds per square inch and an elongation of 22 per cent.

Milling Machine Adapted for Metal Patterns

Built originally as a wood working machine the tool shown in the accompanying illustration has been adapted to finishing patterns made of aluminum and other nonferrous metals. The Oliver Machinery Co., Grand Rapids, Mich., specializing in the manufacture of wood working machines has had the tool on the market for many years, but only recently a few minor changes have been made in the machine illustrated which adapts it to the metal patternmaker's use. It is claimed that either fly cutters may be used at approximately the same speed as would be used in working wood; or regular milling cutters may be used at a slower speed, but at the same time a much faster speed than the regular types of metal working milling machines will operate. Profiling of flat surfaces or around bosses and milling of regular and irregular curves can be accomplished at a rapid rate and at a corresponding saving in the cost of producing metal patterns and coreboxes. The machine is provided with a vertical and a horizontal milling spindle and by means of the rotating, adjustable table the range of application of the cutters practically is limitless.



FINISHING A METAL PATTERN ON A MILLING MACHINE

Large Riser Cut with the Acetylene Torch

A successful method of handling an extremely heavy cutting problem and also the emergency possibilities of the oxyacetylene process are shown in the accompanying illustration. At the plant of a large foundry in Pennsylvania an unusual problem recently was presented in a cylindrical steel riser 5½ feet in diameter, 4 feet long and with a wall thickness of 15 inches. The riser was attached to a casting for an air compressor which weighed 90 tons before and 60 tons after it was cleaned.

Risers have been cut off in various ways at this plant in the past. The smaller risers have been cut off with the acetylene torch and the larger risers cut off in the lathe. The casting shown in the illustration was too large for even the largest lathe in the plant and neither the equipment or the experience of the oxyacetylene men were adequate for such a task.

They tried but after hours of effort had only succeeded in driving the cut through to the inner surface, making a small hole in the riser. The failure to get the cut under way effectively was due primarily to the light torches used and to the fact that they were connected to a single oxygen cylinder.

This condition was remedied by connecting two oxygen cylinders in manifold and by using a heavy service cutting torch. The cut was started at the outer edge of the riser. The panel shown in the illustration was then cut back to where the final cut was to be made. This had the effect not only of facilitating the start on the major cut, but enabled the operator to handle the cut better throughout, as the panel opening made it possible to work from either the

A PANEL FIRST WAS CUT OUT OF ONE SIDE TO ENABLE THE OPERATOR TO WORK FROM EITHER THE INSIDE OR THE OUTSIDE

inner or outer surface at will. Two 50-ton cranes were used to turn the casting as the work progressed. Cutting began at 5 p. m. Saturday and was completed the following day. The total length of the cut including the panel was 25.27 feet, thickness of metal 15 inches and the actual amount of oxygen consumed 7250 cubic feet. The riser itself weighed 9 tons.

Wire Brush Is Attached to Electric Grinder

The Independent Pneumatic Machine Tool Co., Chicago, recently has placed on the market a rotary wire brush designed to be used in connection with its portable pneumatic and electric grinders. It is claimed that the brush attachment makes two tools in one. The brush used on the electric grinder is smaller on account of the higher speed and requires a few attachments not necessary on the pneumatic grinder.

The wires in the brush are all of equal length, they are interchangeable and are made of specially treated steel. The concave wood back which in turn is fittted inside a metal cover secures the brushes in position which also permits of tapered ends or working surface allowing the wires to bend under pressure instead of breaking. This tapered construction is intended to eliminate to a great extent one of the most annoying features in connection with the use of rotary wire brushes.

The brushes find their particular application in the removal of paint, rust, scale, grit, dirt, sand, etc., and it is claimed they can do the work in one-fifth the time required to do it by hand. They also can be employed for cleaning cars, automobile bodies, steel frames, tank cars, castings and sheet metal. When the wires become worn down they may be replaced.

The electric grinder on which this brush is to be mounted is provided with a universal motor for direct or alternating current, or wound for direct current exclusively for either 110 or 220 volts.

Chrome-nickel Castings

A considerable industry has been built up in Great Britain for the manufacture of chrome-nickel alloy castings. This industry centers in Sheffield, the alloy being chiefly used for the manufacture of annealing boxes, pots, tubes, retorts, etc., used in connection with the heat treatment of high-speed steel. Chrome-nickel alloy castings are being made for these purposes up to 2½ tons in weight. This alloy is said to have special fire resisting and corrosion resisting characteristics.

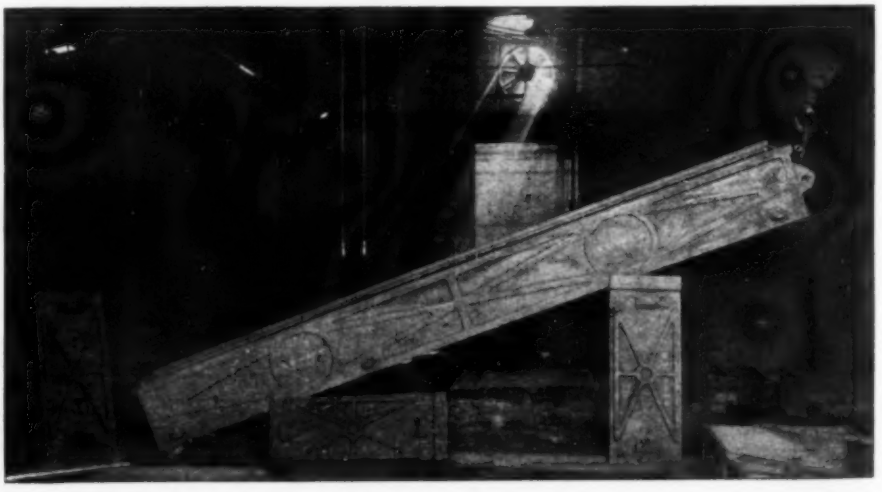
WIRE BRUSH GRINDER ATTACHMENT

One of the leading manufacturers of chrome-nickel alloy castings is Kent Smith, Ltd., Sheffield. The accompanying illustration shows an annealing box made of chrome-nickel alloy in the Kent Smith foundry. This box is used for heat treating mill lengths of high speed steel. The casting is 16½ feet long and weighs 4750 pounds. The castings are molded in sand in the ordinary way, and the chrome-nickel alloy is melted in furnaces similar in a general way, to those used for melting brass or other nonferrous metals.

Addresses Foundrymen on European Conditions

Drawing from his experience in practically all the countries of western Europe during the past two years, where he has had unusual opportunities for observing conditions in the iron, steel and foundry industries, H. Cole Estep, European manager of THE FOUNDRY, addressed the Chicago Foundrymen's Club, March 21, at the most largely attended session it has had in years. He gave some account of the business and social conditions of Europe at present and expressed the opinion that getting back to something like a normal condition is progressing steadily and without untoward incident, and that conditions there are not essentially unlike those in the United States.

In token of appreciation for his address and to further cement the ties resulting from his former membership, the club unanimously voted to make Mr. Estep honorary member of the club.



CAST CHROME-NICKEL ANNEALING BOX WEIGHING OVER TWO TONS

Equipment Inquiry Improves Slowly

Interest is Evidenced By Foundries in All Classes of New Equipment, Although Orders Still Are Reluctant—Replacement and Repairs Are Sought

ALTHOUGH manufacturers of foundry equipment can point to little new business developing during March, a general feeling of better times just ahead is expressed. Inquiries have picked up to a remarkable degree during the past two weeks, and orders for repair and replacement parts indicate an active interest on the part of foundrymen in general in the period which is to follow the depression. Too, a change in the character of the inquiries indicates that this interest is backed by a real intention to buy as soon as the return of better industrial conditions is evident.

New York Replacement Orders Grow

ORDERS for replacement purposes comprise the bulk of activity in the eastern foundry equipment market. An increased volume of inquiry is out, due largely to various plans for changing or increasing production, but these plans, for the most part, are still far from being definitely settled and, consequently, are resulting in little actual buying. An encouraging feature has been a slight improvement in the number of new foundry companies, although practically no large organizations have been affected. Here again little increase in demand has as yet resulted, and, on the whole, the market remains dull, with hesitancy still a dominating factor. Among isolated orders are two tumbling barrels for the North Jersey Foundry Co., Paterson, N. J., and a No. 5 blower for the Franklin Machine Co., Providence, the business going to the Whiting Corp., Harvey, Ill. The Palmer Foundry & Machine Co., Palmer, Mass., which recently increased its capital $70,000 to $135,000 for the manufacture of soil pipe and fittings instead of doing a general jobbing business, is to be in the market shortly for miscellaneous equipment. The White Fuel Oil Engineering Corp., 742 East Twelfth St., New York City, is said to have temporarily postponed action on its proposed foundry. The Sidney Foundry &

Pittsburgh Foundrymen Curtail

PURCHASERS of foundry equipment in the Pittsburgh territory are cutting down on expenditures and what buying is being done represents absolute requirements. The Standard Sanitary Mfg. Co. is understood to be negotiating for foundry equipment of various sorts, including core ovens and coremaking machinery, although up to the present no formal inquiry for molding machines has been issued. This company likewise has made arrangements for cranes for its New Brighton, Pa. expansion and these will be fabricated according to its own designs. Considerable falling off in the inquiry rate on molding machines is noted although requests for prices on air compressors, flasks, and light equipment are fairly numerous. The Herman Pneumatic Machine Co. is awaiting shipping instructions from the Crane Co., Chicago, on a molding machine unit. It is understood that a foundry separate from the company's Kedzie avenue plant, Chicago, will be taken over for bathtub production on molding machines. Complaints are numerous that inquiries do not rapidly turn into orders and the assumption is that buyers expect further concessions in price, and in the absence of urgent needs are inclined to hold up the orders. The Electric Furnace Construction Co., Philadelphia, recently has installed a furnace at the plant of the Electric Steel Products Co., Turners Falls, Mass. Prospective purchasers of foundry equipment are William Fowler, East Bradford, Pa., erecting a 35 x 150 foot foundry; the Independent Sanitary Mfg. Co., DuBois, Pa., planning a new foundry; and the Royer Foundry & Machine Co., recently incorporated by William Williams, Kingstown, Pa., at $60,000.

Chicago Market Remains Dull

DEMAND for foundry equipment and materials is entirely lacking. Engineers and architects specializing in foundries agree with this estimate of the situation. One mixer, manufactured by the National Engineering Co., Chicago, was sold recently to be exported to Brazil. Crane manufacturers find an occasional prospect for a new crane, but sales are not at all in proportion to the number of inquiries. The Graham Pattern works, 260 East Cerro Gordo street, Decatur, Ill., soon will build a new pattern shop and will require additional equipment.

Cleveland Buyers Reluctant

LITTLE improvement is noted in the orders for foundry equipment in this district, although a greater volume of inquiry and a tendency to follow inquiries by actual investigation has brought encouragement to manufacturers. The Manufacturers Foundry Co., Erie building, Cleveland, recently has secured a factory building and contemplates the manufacture of jobbing castings. The Sandusky Foundry & Machine Co., Sandusky, O., has purchased a 15-ton crane from the Whiting Corp., Harvey, Ill. The General Fire Extinguisher Co. has purchased a 7½ cubic yard sand mixer from the Standard Sand & Machine Co., Cleveland.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Burger Foundry Co., Aldene, N. J., has been incorporated with a capital stock of $100,000, by Leopold and John Burger and Peter Godek, to manufacture iron and steel castings, etc.

The Florence Pipe Foundry & Machine Co., Florence, N. J., plans the erection of a pattern shop, 50 x 100 feet.

The S. B. Sexton Stove & Mfg. Co., 500

West Conway street, Baltimore, plans the erection of a foundry building, 100 x 135 feet.

The plant of the Colonial Brass Co., Middleboro, Mass., recently was damaged by fire.

The M. & A. Brass Foundry Co., Dayton, O., has been organized by Logan Moser, and others.

Harry Schmock, Springfield, Mo., plans the erection of a foundry building, 50 x 50 feet.

Erection of two plant buildings is planned by the Buckeye Casting Co., Lima, O.

Ground has been broken by the Whitcomb Foundry & Machine Co., Kenosha, Wis., for the erection of an addition to its plant, 30 x 100 feet.

The A. E. Martin Foundry & Machine Co., Milwaukee, has a permit to build an addition to its plant, 30 x 36 feet.

Plans are under consideration by the Hercules Gas Engine Works, Evansville, Ind., for improvements and alterations to its foundry.

Whitesides & Son, Plainview, Tex., have purshased a site on which to erect an iron working shop and foundry.

Contract has been let by the Builders' Iron Foundry, Providence, R. I., for the erection of a plant building.

The Greenmount Iron & Mfg. Co., Baltimore, plans some improvements to its foundry building.

The casting building at the plant of the New Milford Foundry & Machine Co., New Milford, Conn., recently was damaged by fire.

The Harris H. Uris Iron Works, Inc., 525 West Twenty-sixth street, New York, plans the erection of a plant building.

The Grand Rapids Malleable Iron Co., Grand Rapids, Mich., plans the erection of a plant building, 35 x 66 feet.

The Hanford Iron Works, San Bernardino, Cal., has just completed its steel foundry which is equipped with a 2-ton electric furnace.

The Unit Stove & Range Co., Birmingham, Ala., is reported planning to install equipment for the manufacture of stoves.

Erection of an addition to its plant is being contemplated by the Keeley Stove Co., Columbia, Pa., according to a report.

William Fowler, East Bradford, Pa., is reported planning the erection of a foundry building, 35 x 150 feet.

Capitalized at $10,000, the Hunts Iron Works, New York, has been incorporated by L. Kopelson, G. and E. Lippert, 2555 Third avenue, New York.

The Connecticut Blower Co., 135 Sheldon street, Hartford, Conn., recently increased its capital stock and is reported planning the erection of a new plant building, 50 x 175 feet.

The Chicago Art Bronze Works, 38 South Dearborn street, Chicago, has been incorporated with a capital stock of $25,000, by G. A. Smith, E. P. Page, C. B. O'Neil, and others.

I. Cohen & Sons, 36 Prince street, Montreal, Que., has awarded a contract in connection with the erection of an addition to its foundry building.

The Keystone Iron & Steel Works, Los Angeles, has placed an order for a 3-ton Moore furnace and expects to begin operations in its new foundry in 90 days.

J. K. Fawcett, 835 North St. Clair street, Pittsburgh, and associates, have organized the Pennsylvania Mold & Iron Co., to engage in the manufacture of castings and kindred products.

The Economy Pattern Works & Mfg. Co., 2264 East Fifteenth street, Los Angeles, has been organized by B. G. Funk, Charles Reed, and others.

The Modern Iron Works, New York, recently was incorporated with a capital stock of $5000, by S. and L. Sternin, and S. Chiaet, 77 East 119th street, New York.

The Edwin Poulton Foundry Co., Columbus, O., is expected to start full operations about April 1 in its new plant building on West Goodale street. The plant will open with a force of 50 men. The building is so constructed that an addition can be made to it at any time.

The Sterling Brass Co., Cleveland, has had plans prepared for the erection of a brass foundry and machine shop, 2-stories, 75 x 90 feet.

Capitalized at $10,000, the Ludlow Iron Products Co., Philadelphia, recently was incorporated by H. E. Penney, 23 South Sixty-first street, and others.

A permit has been granted the Nation Steel Foundries, Milwaukee, division of the National Brake & Electric Co., to remodel its laboratory building.

Capitalized at $50,000, the Ohio Aluminum & Bronze Foundry Co., Canton, O., recently was incorporated by S. J. Deutsch, L. J. Rotschild and C. Rosenblatt.

The Taft Metal Pattern & Mfg. Co., Cleveland, recently was incorporated with a capital stock of $10,000, by F. W. Taft, W. A. Gluntz, and others.

The Pepple Pattern & Mfg. Co., Lima, O., recently was incorporated with a capital stock of $50,000, by Ross Pepple, Allen Patterson, and others.

Capitalized at $150,000 the Victory Foundry & Machine Co., Buffalo, recently was incorporated by M. Kimball, M. T. Sullivan and J. Tick.

The Julian Pump & Mfg. Corp., Jamestown, N. Y., has been organized with a capital stock of $500,000, and has acquired a plant building in which it will operate.

The Llewellyn Iron Works, Los Angeles, is now operating in its new foundry. This is said to be the largest plant of its kind on the Pacific coast, having a capacity of 100 tons a day. The plant is 170 x 350 feet.

Iron and steel castings, machinery, etc., will be manufactured by the Royer Foundry & Machine Co., Wilkes-Barre, Pa., which was recently incorporated with a capital stock of $60,000, by W. M. Williams, Kingston, Pa., and others.

Capitalized at $500,000, the John W. Olsson Corp., York, Pa., recently was incorporated by John W. and Fritz V. Olsson and John E. Urich, to manufacture iron and steel castings and kindred products.

The Chapman Valve Mfg. Co., Indian Orchard, Mass., is taking bids on a brick, concrete and steel, fireproof, 50 x 275-foot with two wings, each 20 x 275-foot, foundry. It will be equipped with annealing furnaces, pattern shop, sandblast and compressor rooms, etc.

The W. N. Thompson Midway Machine & Garage Co., Burlington, N. C., is the name of a new company recently organized to operate a machine shop, garage and foundry. J. G. King is manager. A new foundry plant will be installed and other improvements made.

The Arcade Malleable Iron Co., Worcester, Mass., has purchased the Richard French Iron Works, its 1-story factory building and one acre adjoining, and will use it for storage purposes. The Richard French Iron Works has had plans prepared for a new plant in another location, which as yet has not been disclosed. The reason given for selling was that the building had been outgrown.

Articles of incorporation have been filed by the North Side Brass Foundry Co., Milwaukee, which has been organized with a capital stock of $25,000, to manufacture brass, bronze, and aluminum castings. The incorporators are A. Urbanek, W. C. Raasch and L. Palck.

Bids have been taken by Alfred Box & Co., Inc., Philadelphia, on the erection of an office and pattern shop building, and bids will shortly be opened on a machine and structural shop, to be 110 x 300 feet. The company, which manufactures cranes and traveling equipment, will move to its new plant when it is completed. It is not in the market for equipment.

Work on four buildings for the new West Milwaukee plant of the Chain Belt Co., Milwaukee, has been completed. This plant was designed by Frank D. Chase, Inc., engineer, Chicago, and is built along most modern lines of plant construction. One building will be used for the manufacture of mixers and pavers, and provision has been made to convert the structure into a malleable foundry at later date. The coremaking building is of combination reinforced concrete and structural steel construction, the first two floors being of concrete while the third is of steel construction. The first floor will be used for pattern storage, the second as a metal pattern shop and the third for core making. In this structure disposal of hot gases and smoke is provided for by the truss type of roof, which also allows for perfect lighting. The foundry building addition has an "A" frame roof construction and is well lighted and ventilated. An extension to the power house was also erected.

Plans are being completed for the erection of a small building for Morton McI. Dukehart & Co., Baltimore, which when completed will be devoted to small jobbing work in iron castings. The company will require some foundry equipment, but as work on the proposed structure is not contemplated for some time, purchases will not be made until actual construction has been decided upon.

Formerly known as the Powdered Coal Co., and prior to that as the Combustion Economy Corp., 1901-11 South Rockwell street, Chicago, the organization will hereafter do business under the name of the Grindle Fuel Equipment Co. The capital stock of the company has been increased to $1,000,000 and plans are now being prepared for the erection of a manufacturing and demonstrating plant, consisting of a foundry, machine and sheet metal shop, office and engineering department, a complete powdered coal preparation plant and other departments necessary for the manufacture of powdered coal equipment. The plant will utilize powdered coal for fuel and a conveying system and firing equipment will be installed. It is expected the plant will be located in Chicago and it is hoped it will be ready for operation the latter part of this year.

New Trade Publications

CRANES—The Milwaukee Electric Crane & Mfg. Co., Milwaukee, has published a 48-page illustrated booklet in which electric cranes, hoists and horizontal drilling and boring machines are described and illustrated. Some of the leading features of the electric cranes, pointed out in the booklet are: All parts are strong, rigid and accessible; bearings are self-oiling and arranged so as to prevent the escape of oil and the entrance of grit and dust; bridge truck and trolley truck bearings are arranged for oil and wool waste lubrication; bridge end trucks are of structural steel with cast steel brackets, designed so that the load is evenly divided.

INDUSTRIAL PUBLICATION—Frank D. Chase, Inc., Chicago, is circulating the January issue of its publication *Industry*. This issue contains a number of interesting articles, among which is one by Frank D. Chase on "The Employer's Analysis of an Engineer." Valuable information is given in another article entitled "How to Get a Foundry That Fits," by L. M. Hansen. This article is accompanied with typical layouts of malleable, gray iron and steel foundries, with dimensions of yards, melting equipment, molding area and core rooms. Other interesting articles are given in the booklet which is of 32 pages.